The Build-Safe Macromodule of the DrHouse Project

M. Dolce & A. Goretti
Civil Protection Department, Seismic and Volcanic Risk Office, Rome, Italy

A. Pavese
University Eucentre, Via Ferrata 1, 27100 Pavia, Italy

L. Ponticelli
Ministry of Interiors, Fire Brigade Department, Rome, Italy

SUMMARY:
Within the "Civil Protection Preparatory Action on an EU Rapid Response Capability", the European Commission funded the DrHouse project, aimed to design, prepare, maintain and possibly deploy, up to a distance of 15.000 Km, an European Civil Protection macro-module for safety assessment of buildings damaged by earthquakes and their immediate propping and shoring. The macro-module, named "Build-Safe", is composed by 3 different modules, the first one is dedicated to standard, visual, building damage and safety assessment (Basic Safety Assessment, BSA), the second one is aimed to an advanced experimental-numerical assessment (Advanced Safety Assessment, ASA), and the third one to the execution of short term countermeasures on damaged buildings (Short Term Countermeasures, STC). The paper, after introducing the European Civil Protection Mechanism, describes the DrHouse project and the three modules (BSA, ASA and STC), highlighting the challenge of assuring an immediate deployment.

Keywords: European Civil Protection Mechanism, Modules, Damage and safety assessment

1. INTRODUCTION

The European Commission program "Civil Protection Preparatory Action on an EU Rapid Response Capability" is funding the preparation of a rapid response capability in case of international emergencies, to be activated under the EU Civil Protection Mechanism. Under this program, the Commission has funded the project DrHouse, addressed to the design, implementation, preparation, maintenance and possible deployment, up to a distance of 15,000 kilometers, of a European Civil Protection macro-module on the usability evaluation of buildings damaged by earthquakes and the subsequent safety measures. The macro-module, named "Build-Safe", consists of three modules, the first one aimed at evaluating with a conventional, visual, approach the safety and the damage of buildings (Basic Safety Assessment, BSA), the second one aimed at assessing buildings with an advanced numerical and experimental approach (Advanced Safety Assessment, ASA), and the third one to building propping and shoring (Short term Countermeasures, STC). The project coordinator is the Italian Civil Protection Department, which deals with everything related to the BSA module. The other project participants are the Eucentre Foundation, responsible for the ASA module, and the Fire Department, Public Aid and Civil Defence, responsible for the STC module.

The article, after describing in detail the European Civil Protection Mechanism, describes the DrHouse project and the three modules of intervention, focusing on the features of the international technical emergencies and on what is necessary for an immediate deployment.

2. THE EUROPEAN CIVIL PROTECTION MECHANISM

The European contribution in the context of civil protection comes after an incredible series of natural disasters and environmental catastrophes that occurred in European Union and candidate countries, in

the late '90s: from the earthquake in Greece and Turkey to the sinking of the oil tanker Erika in France, from floods to forest fires that hit many countries, including Italy. Following these events, the European Commission matured the need to adopt common measures aimed at better coordination of civil protection intervention in case of disaster.

The formulated hypothesis was focused on setting up a mechanism to enable Member States to pool resources for civil protection at European level: the European Civil Protection Mechanism. This would necessarily respect the national competences, fulfilling one of the basic rules of the EU, namely the principle of subsidiarity, and pursue, at the same time, the objective to support and encourage efforts in the national actions to be taken in case of disasters. This instrument was also expected to enable the ability to quickly organize additional resources at European level, drawing on the resources offered by other countries, at the request of the one affected by an emergency. The primary achievement of this goal necessitated the European Commission taking a coordinating role and the Member States expressing their willingness to make available an adequate number of arrangements for civil protection assistance to other countries. It was therefore initiated the establishment of a legal basis which was achieved in October 2001 creating the European Civil Protection Mechanism in order to facilitate cooperation against serious emergencies occurring inside or outside the EU. The legal instrument was the Council decision n. 2001/792 of 23 October 2001 (OJEU 2001).

Currently the European Civil Protection Mechanism responds to emergencies that occur in an area inside or outside the EU, through the sharing of resources of all participating States. They are part of the European Civil Protection Mechanism the 27 European Union member states, the 3 countries belonging to the European Economic Area (Norway, Iceland and Liechtenstein) and the Croatia. The mechanism is always activated in coordination and at the request of the affected State, in a different way when it comes to activities inside or outside the EU.

Within the European Union: a Member State that it is not able to cope with the disaster may request assistance to other Member States, activating the MIC, which, once the request received, informs all the countries of the mechanism. The communication is performed through CECIS, a system that allows an immediate dialogue between the Member State crisis rooms, usually operating 24 hours a day. Within this system, the requests of assistance from the affected country and the offers from countries that decide to intervene appear. Through the CECIS all participating States are informed and updated on the progress of the emergency until its conclusion. The type of intervention varies depending on the event. The MIC then facilitates the mobilization of assessment and/or coordination teams, experts, civil protection modules, etc. and ensures the co-financing of the transport of the assistance offered by the participating States, while leaving the management of the assistance to the requesting State.

Outside of the European Union: the mechanism can be activated by a request for assistance to the MIC by the affected country. In these cases, the High Representative for Foreign Affairs and foreign policy together with the Member State holding the Presidency of the European Council, coordinates the policy response in consultation with the Commission. This ensures the connection with the affected country, facilitating the rapid deployment of the EU assistance, especially in the early hours of the event. In the case where the UN is in the affected country, the latter hold the leadership role of the operations. The activity carried out by the Directorate General for Humanitarian Aid and Civil Protection of the European Commission (DG-ECHO) is done in close collaboration with the UN Office for the Coordination of Humanitarian Affairs - OCHA.

The mechanism operates through civil protection modules, introduced after the 2004 Banda Aceh tsunami. The modules are specialized units of intervention composed of personnel, material and equipment provided by the participating countries and "packaged" according to job function and to specific criteria. The modules can be deployed in a short time abroad, and are self-sufficient, interoperable, and capable of operating independently or together with other modules, but according to international guidelines. Currently, after the Council decision n. 481 of 2010 (OJEU 2010), the Mechanism provides for the following 17 modules:

1. High capacity pumping
2. Water purification
3. Medium Urban Search and Rescue
4. Heavy Urban Search and Rescue
5. Aerial forest fire fighting module using helicopters
6. Aerial forest fire fighting module using airplanes
7. Advanced Medical Post
8. Advanced medical post with surgery units
9. Field Hospital
10. Medical aerial evacuation of disaster victims
11. Emergency temporary shelter
12. Chemical, biological, radiological and nuclear detection and sampling (CBRN)
13. Search and rescue in CBRN conditions
14. Ground forest fire fighting
15. Ground forest fire fighting using vehicles;
16. Flooding containment;
17. Flood rescue using boats

3. THE DRHOUSE PROJECT AND THE BUILD-SAFE MACRO-MODULE

The EU grant program "Preparatory Action on an EU Rapid Response Capability" of the Civil Protection DG-ECHO, having recognized the importance of identifying new fields of activity for civil protection teams, has financed for 3 years the design and the implementation of new modules. Within this framework the Project entitled "Development of Rapid Highly-specialized Operative Units for Structural Evaluation, DrHouse" has been funded by the European Commission. It began on 1 June 2010 and lasts 24 months.

The aim of the DrHouse project is to develop and implement a new Civil Protection Macro-Module for post-earthquake damage and usability assessment of buildings and implementation of temporary safety measures. The project builds upon the experience developed within previous EU projects such as LessLoss, Tripod and Step. The module is to be used in international emergencies and has to be rapidly deployed abroad up to a distance of 15,000 km from Italy. The target is to enhance the European Rapid Response Capability (ERRC) within the European Civil Protection Mechanism. The overall budget is 1,879,664.00 €. The European Commission grant is 90% of the eligible costs. The remaining 10% is co-funded by the Partners. The Project is jointly carried out by the Italian Department of Civil Protection (DPC, Coordinating Beneficiary), the Eucentre Foundation, Italy, and the Italian Department of Fire, Public Rescue and Civil Defence (VVF).

The Macro-Module is named Build-Safe and is composed by three modules consisting of trained personnel and up-to-date equipment and technology, namely:

- Basic Seismic Assessment Module (BSA) for post-earthquake conventional damage and usability assessment of ordinary buildings.
- Advanced Seismic Assessment Module (ASA) for seismic assessment of strategic and/or complex structures with dedicated advanced numerical and instrumental procedures.
- Short Term Countermeasures Module (STC) to prop up and shore damaged structures.

The structure of the Build-Safe macro-module is illustrated in Figure 1.

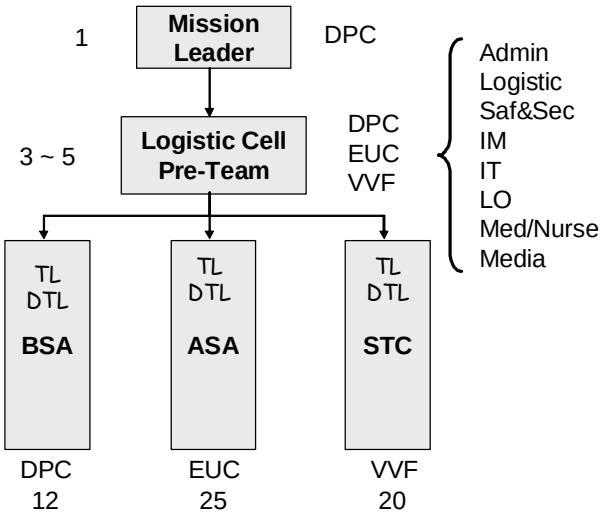

Figure 1. Outline of the Build-Safe macro-module

The tasks of the project are the following:

- Task A. Project management
- Task B. Design and Implementation of the Capability
- Task C. Simulation Exercise
- Task D. Deployment
- Task E. Training
- Task F. Dissemination
- Task G. European networks of experts

Task B is the core of the project whose objective consists in the undertaking all the arrangements such that the full capability will be available to be immediately deployed. It includes the following actions:

- B.1 Up to date inventory of the available capacities/resources
- B.2 Analysis of needs for the establishment of an efficient capability
- B.3 Design and implementation of the capability
- B.4 Preparation of the self-sufficiency
- B.5 Interoperability: interaction among BSA, ASA and STC
- B.6 Standard Operating Procedures (SOP) for the emergency activation
- B.7 Standby arrangements and maintenance
- B.8 Functional Support Activities

The Macro-Module capability has been designed in order to ensure self-sufficiency and interoperability of the modules according to the requirements for European Civil Protection modules. The design of the modules implied also the preparation of all the means adequate to the functions to be supplied, including both human resources and equipment. Roles, persons and operating turnover have been designated to supply all of the functions of the three modules. The modules can be deployed independently as well as together and can guarantee at least 15 days of operation on site. Cars, vans and tracks are foreseen for road deployment up to about 4.000 km of distance. In case of longer distance, personnel, equipment and logistic will be air transported and cars, vans and tracks will be rented on site. A camp will be set up on site for the 3 modules. Since no request of deployment has been requested by the MIC within 2012, a full-scale exercise to test the rapid response capability of the Macro-Module will take place in the next months, with the participation of experts and observers from other EU Member States.

The training was an essential part of the project. Training courses have been developed on BSA, ASA and STC activities, and a total of about 100 technicians have been trained for each module. Proper communication and visibility activities have been also implemented by the Partners in order to ensure adequate publicity to the project actions. The logo of the project is shown in figure 4.

4. THE BSA MODULE

The BSA Module is coordinated by DPC and aims at performing post-earthquake damage and usability assessment of ordinary buildings based on visual inspection and expert judgment. The module is composed by 12 highly qualified professionals from DPC, Universities of the ReLuis Consortium and Italian Regions. The module can operate as follows:

- 6 teams of 2 people each, or
- 6 teams of 2 people each and a local expert technician, or
- 12 teams of 1 person each and a local technician.

The presence of local technicians could be required to access the damaged buildings, or to establish a relationship with the local population. In order to maximize the impact of the intervention, the BSA module has been designed in order to be able to perform several activities, depending on the Local Authorities requirements:

- Safety classification of buildings;
- Damage classification of buildings;
- Identification of buildings to be demolished;
- Identification of buildings to be repaired;
- Training of local technicians;
- Coordination of building inspection activities.

The rapid evaluation is typically based on the exterior conditions of the buildings, unless the building can be adequately inspected from the interior as well. Survey data will be collected using either local (when available) or international inspection forms. The teams are trained to use most of the international field forms for rapid post-earthquake inspections, e.g., AeDES (Italy), STEP (EU), ATC-20 (USA), and those adopted by Cyprus, Slovenia, Greece, Romania, Turkey, Colombia and Japan (Figure 2).

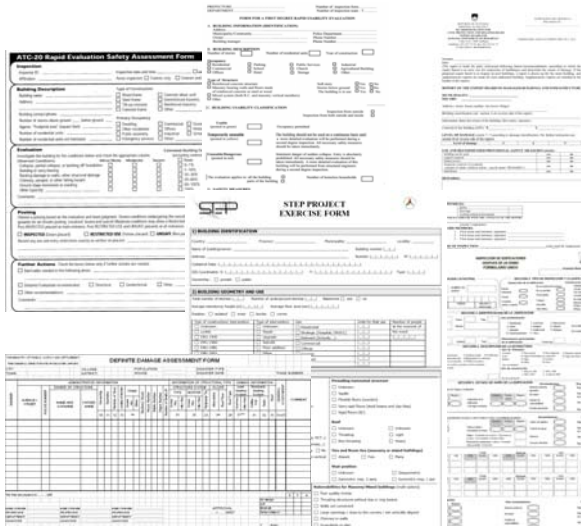

Figure 2. International inspection forms available for safety assessment

In order to improve efficiency, inspections can be also carried out with IT systems such as palms and digital pens. The BSA teams will rate the buildings as safe for occupancy or entry, potentially unsafe (i.e., restricted use because of hazardous condition; building to repair), or unsafe (imminent risk of further damage or collapse; heavy repair measures or demolition). The survey results will allow Local Authorities to decide on the actions to be undertaken, for instance ordinances for people to be evacuated, ordinances for building demolition, etc. Each team can inspect 11 to 13 buildings per day,

leading to a total of 70 building inspections/day for the whole Module. Building inspections can increase up to 25-30 buildings/day/team depending on the building dimension and damage level, but mainly on the type of information required by Local Authorities. In this case, about 200 inspections per day for the whole module are expected. The BSA Module is self-sufficient and inter-operable with ASA and STC modules. It is equipped with GSM, satellites mobiles INMARSAT, and BGAN satellite terminals. About 100 technicians have been trained within the BSA Module on the EU Civil Protection Mechanism, international methodologies and procedures of safety and damage assessment, advanced IT for data collection, international emergency, logistics, safety and security, media contacts.

Figure 3. Pictures from BSA module training courses

In order to enhance the visibility of the module during the emergency, clothing has been specifically designed and manufactured (Figure 4).

Figure 4. Build-Safe logo and BSA module clothing

5. THE ASA MODULE

The ASA Module is coordinated by Eucentre and it is aimed at performing fast post-earthquake structural evaluation of strategic or complex structures using combined numerical and experimental techniques. The ASA Module is composed of 24 people trained on structural assessment of buildings and can support BSA teams for visual usability evaluation of ordinary building. ASA teams adopt state-of the art advanced testing instrumentation and monitoring techniques to collect relevant data on existing structures. ASA technology is based on the technology developed within the European STEP

project (Strategies and Tools for Early Post-Earthquake Assessment). Particularly, a special mobile unit (MU) equipped with instrumentation, workstations and servers, is used to perform and coordinate experimental testing activities as well as advanced assessment of buildings. The mobile unit has also functions of data repository and wireless hub. Field data will be transferred from ASA teams to MU via satellite connections and wireless technology. The safety assessment is based upon a detailed geometrical survey of the building and non-destructive in-situ tests and can be performed on multi-storey reinforced concrete or pre-cast buildings, masonry buildings, towers, churches and landslides. The main objective is to estimate both the damage level and the residual capacity of the structures. Moreover, the collected data and analysis outcomes might be shared with experts in remote laboratory or institutions.

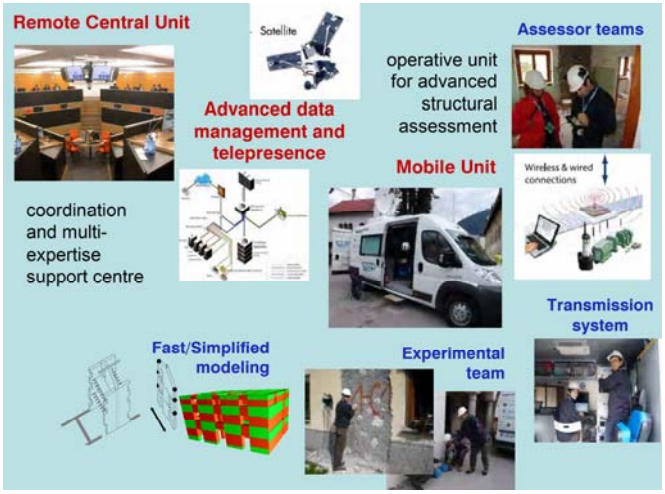

Figure 5. ASA module activity

A total of about 100 technicians have been trained within the ASA Module on non-destructive experimental testing, numerical modelling and structural assessment of buildings. The ASA Module is self-sufficient and inter-operable with BSA and STC Modules.

6. THE STC MODULE

The STC Module is coordinated by the Fire Brigade Department and is aimed at implementing short term countermeasures to earthquake-damaged buildings and historical construction, both to allow secure access to the buildings and to preserve the buildings from further damage. The STC Module is composed by 2 highly specialized teams of fire fighters as illustrated in figure 6.

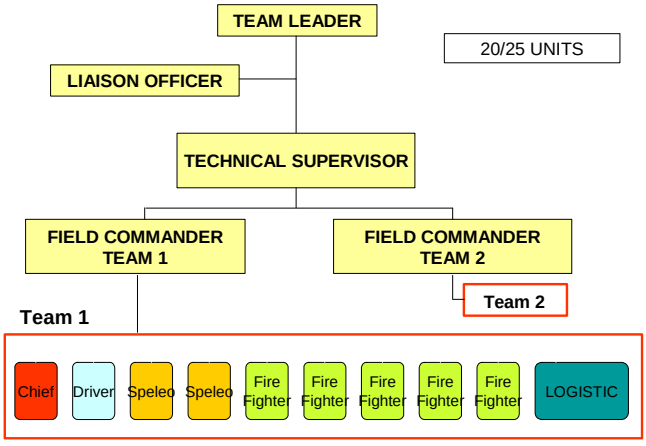

Figure 6. STC Module composition

Propping and shoring of buildings could be implemented with or without the preliminary building inspection by the BSA teams. The selection and the design of the interventions follow the standard operating procedures reported in the "Vademecum STOP" and will be agreed with the local authorities. The Vademecum "STOP" comes from the large experience gained by the Fire Brigade Department on short term countermeasure after the recent Italian earthquakes. It has been prepared by the Provisional Works Coordination Unit (NCP) of the Fire Brigade, with the contribution of the Italian Corps of Engineers under the scientific coordination of University of Udine, Italy. Relevant examples of short term countermeasures are illustrated in Figure 7 and 8. About 100 fire fighters have been trained on temporary safety measures, international disasters and emergencies.

Figure 7. Sant'Eusanio Martire Church, Sant'Eusanio Forconese (AQ). Shoring type STOP PR R3.

Figure 8. Santa Margherita Church, L'Aquila (AQ). Tightening of the apse wall and main barrel vaults.

7. CONCLUSIONS

In the present work the DrHouse the project, funded under the European Commission program "Civil Protection Preparatory Action on an EU Rapid Response Capability" was presented. The project addresses the design, implementation, preparation, maintenance and possible deployment, up to a distance of 15,000 kilometers, of an European civil protection macro-module for damage and safety assessment of buildings damaged by earthquakes and the subsequent safety measures. The macro-module, identified with the name of "Build-Safe", consists of three modules, the first for a conventional, visual, assessment (Basic Safety Assessment, BSA), the second for an advanced numerical and experimental assessment (Advanced Safety Assessment, ASA) and the third for propping and shoring damaged buildings (Short Term Countermeasures, STC).

The difficulties encountered during the course of the project were not technical or scientific, but rather organizational. In particular everything necessary to ensure the immediate deployment and the on site operation of the modules turned out to be a formidable problem. From this point of view, preparatory activities, including the definition of pre-arrangements, to solve or minimize problems of passports, visas, vaccinations, air transportation of people and vehicles, entry of technological equipment in third countries, safety and security, first aid, accident and sickness insurance, third party liability, etc., were essential. Equally important was the establishment of a logistical base camp to ensure self-sufficient life and activities for 15 days and about 75 people. It includes tents, cots, sanitation, field kitchens, food, water, generators, air conditioners, lighting, etc. The modules have also technological equipments to ensure communications, such as GSM and satellite phones, BGAN terminals, etc.

The challenge will be the real deployment of the module within 72 hours of notification by the MIC, anywhere in the world and up to a distance of 15,000 km. Also in this case the deployment procedures and the required documentation, such as loading list, equipment list and personnel list, were prepared in advance. In case of deployment a pre-team is able to leave Italy in few hours from the request, in order to facilitate the arrival of the macro-module in the affected country.

Ultimately the DrHouse project has allowed on one hand to expand the horizons of technical activities in emergency and on the other hand to focus the participants' attention on deployment preparation and on operations in difficult conditions.

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REFERENCES

Official Journal of the European Union of 15/11/2001, Council Decision n. 2001/792 of 23 October 2001, (2001/792/CE, Euratom).

Official Journal of the European Union of 07/09/2010, Council Decision n. 2010/481 of 19 July 2010 (2010/481/CE, Euratom)

European Commission, DG-ECHO, 2010. DrHouse Grant Agreement n. 070405/2010/565717/SUB/C3