United Nations
Educational, Scientific and
Cultural Organization

World Heritage Convention

Report of the Mission to the earthquake affected areas in the Emilia and Lombardy regions of Italy

7-8 June 2012

UNESCO World Heritage Centre

1. Introduction

Following the earthquakes that hit the region of Emilia in Northern Italy since May 20 2012, UNESCO has dispatched an urgent technical mission with the objective of assessing the overall situation at the affected World Heritage Properties. The mission, which was composed of Mr. Giovanni Boccardi (World Heritage Centre), Professor Daniele Pini (University of Ferrara) and Prof. Claudio Margottini (ISPRA), was also aimed to evaluate the current risks related to the evolution of the seismic phenomenon and collect information on the strategy put in place by the competent Italian authorities to mitigate these risks and plan for the recovery.

The Mission took place on 7 and 8 June 2012 and visited the three World Heritage properties affected by the earthquake, i.e. 1) Mantua and Sabbioneta; 2) the Cathedral, Torre Civica and Piazza Grande, Modena; and 3) Ferrara, City of the Renaissance, and its Po Delta. These are located at relatively short distance from each other (and from the epicenters of the main seismic events) within one of the most important cultural and economic districts of Italy, producing over 1% of the national GDP and renowned for its car, high-precision mechanicals and food industries. At each of the three World Heritage properties, the Mission met with representatives of the local authorities, of the Italian Ministry of Cultural Properties and Activities, of the Church, as well as of other institutions concerned.

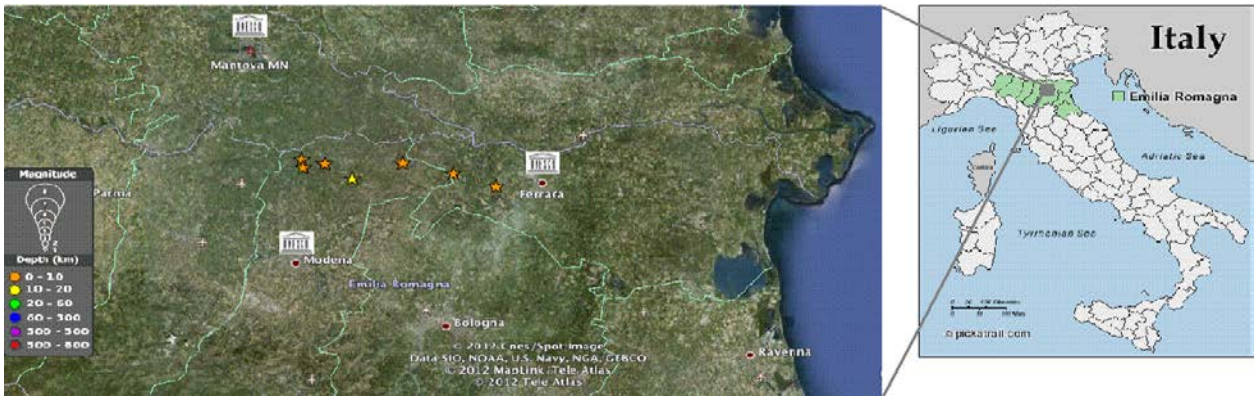

Fig. 1 – The epicenters of the main seismic events and the location of the three affected World Heritage properties. The province of Mantua is located in the region of Lombardy.

Travelling between these sites, the Mission had also the opportunity to briefly pass through the areas nearest to the epicenters, where most of the casualties and destruction were suffered, including to very important cultural heritage properties. Annex I to this report contains a list of the places visited and of the persons met.

The three sites affected by the earthquake are very different. The World Heritage property of Modena is a monumental site comprising only the Cathedral, the Civic Tower - called the “Ghirlandina”- and the surrounding "piazza". The complex is considered a “supreme example of early Romanesque art”, mostly dating from the 12th century, of exceptional architectural and sculptural quality. “Mantova and Sabbioneta” is a serial property including two inhabited historic urban centres, outstanding examples of Renaissance town planning both on a pre-existing urban context and *ex nihilo*; “Ferrara and the Po Delta”, lastly, is a large site including the historic city of Ferrara and the surrounding cultural landscape, characterized by suburban residences and a complex network of waterways along Italy’s main river (the ‘Po”), embodying the humanist concept of the 'ideal city', with its new principles of “perspective”, and of idyllic rural life.

It is important to stress that the seismic activity – which had not been anticipated in this part of Italy, at least with this intensity - was at the time of writing of this Report still underway along a large fault extending east-

west to the south of the Po River, and that almost 80 small aftershocks occurred even during the two days when the Mission took place. The possibility of new strong earthquakes, thus, cannot be excluded and is one of the main concerns of the Italian authorities as well as of the people living in the area.

2. Seismic phenomena. Characteristics and current evolution

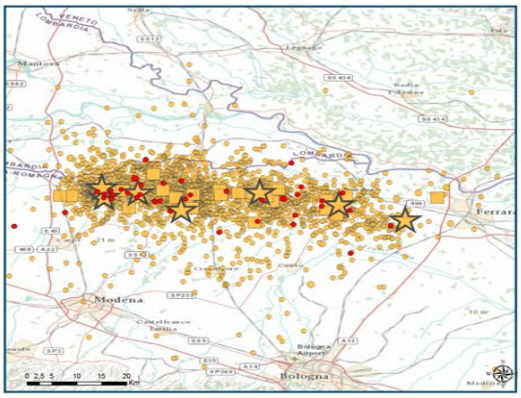

fig. 2 – Seismic sequence in Northern Italy in the period 15 May 2012 – 15 June 2012 (source , http://www.ingv.it/)

On May 20, 2012 at 04:03 EU time, an Mw 5.9 earthquake hit an extensive area of the Emilia Po-River Plain between the Modena, Ferrara, Rovigo and Mantua provinces. Since then, the seismic sequence included more than 1.800 shocks in all classes of magnitude, distributed along a 50 km-wide East-West structure (fig. 2). Seven of these shocks reached an energy content M>5.0. All data provided in this section of the report come from the Italian National Institute of Geophysics and Volcanology (INGV).

The epicenters were located close to villages of Mirandola, Finale Emilia and Bondeno, causing 28 casualties and severe damage both within the historical parts of the towns as well as in the industrial areas. The sequence of earthquakes began with a main shock on 20 May (M=5.9) accompanied by two other events with M=5,1 on the same day. Important damage was then caused by a second earthquake occurred on 29 May, with M=5.8, which hit monuments, buildings and industrial structures strongly weakened by previous events. At one month from the beginning of seismic sequence, the release of energy is apparently diminishing (fig. 3).

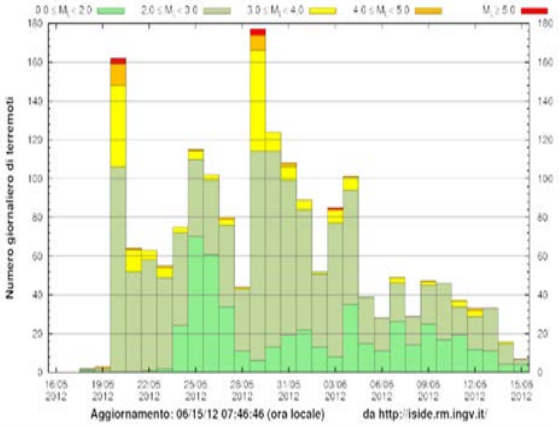

Figure 3 – Daily number of earthquakes in the period 15 May 2012 – 15 June 2012-06-15 (source: http://www.ingv.it/)

Earthquakes in these areas derive from compressional movements affecting the Po River plain, comprised between the Apennine and Alps mountain ranges, with velocity of some mm per years. The tectonic cross-section of the region (see Fig. 4) shows evident compressional structures and the earthquakes are likely associated to faults originated by their relative movements.

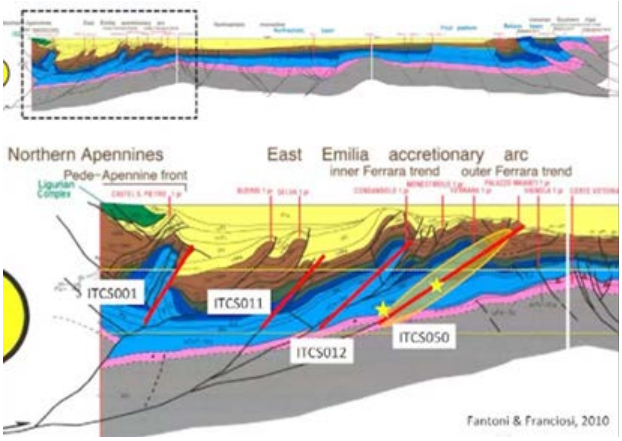

Figure 4 – Tectonic section of the Po river plain from South to North, showing with superimposed yellow area and stars the fault likely responsible for the current seismic events. (Source: http://www.ingv.it/)

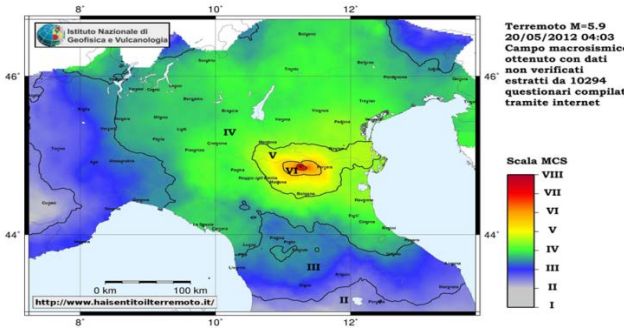

Figure 5 - The macro-seismic field of 20 May 2012 (source INGV, http://www.ingv.it/)

The earthquake was felt in almost all of Northern Italy (figure 5) with major damage in the area of Mirandola, Finale Emilia and Bondeno, as already mentioned. In this area, the seismic intensity was evaluated between VI and VII-VIII of the Mercalli Cancani Sieberg (MCS) scale. Within this scale, a grade VIII is producing a widespread damage in almost all buildings and the collapse on many old and vulnerable structures. Figure 5 describes the macro-seismic field obtained from an internet questionnaire.

An additional parameter of particular relevance for the impact of an earthquake on the building stock is the ground motion, which has been measured through the National seismometric network of INGV. This indicates that a peak ground acceleration (PGA) > 0,24 g has been recorded near the epicenter. According to measurements made by the INGV, a PGA of 0,019 g was recorded close to Mantua and of 0,037 g in Modena. Interpolating the available data, it is possible to affirm that the PGA in Ferrara was between 0,024 and 0,057. When considering local macro-seismic data (Margottini *et alii*, 1987), these levels of PGA should lead to earthquakes of intensities ranging between IV MCS in Mantua, V in Modena and V-VI in Ferrara, with VI being the threshold at which some level of damage occurs in buildings.

The fact that damage was observed to historic buildings within areas where the intensity of the earthquake was less than VI MCS (such as in Mantua) suggests that these might have been (and possibly still are) highly vulnerable and in need of strengthening measures.

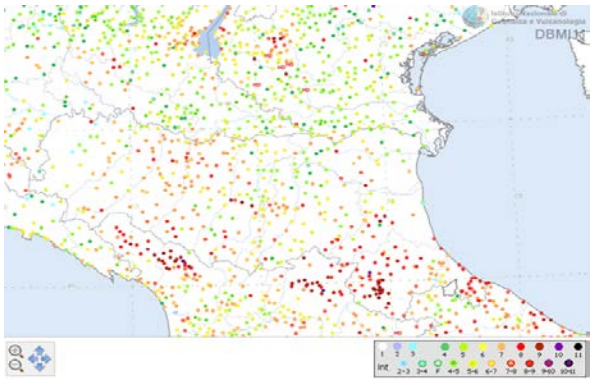

Figure 6 – Max registered historical earthquakes on Italian locality since 1000-2006 (M. Locati, R. Camassi e M. Stucchi (eds.), 2011. DBMI11, the 2011 version of the Italian Macroseismic Database. Milano, Bologna, http://emidius.mi.ingv.it/DBMI11.)

Finally, it is important to note that, while the area affected by the earthquakes was considered - until 20 May – at relatively low risk from this type of hazard, a number of seismic events had been recorded in the past in the region, as shown by the database of Italian historical earthquakes (http://emidius.mi.ingv.it/DBMI11/). This indicates for Ferrara a maximum historical intensity of VIII MCS in 1570, for Modena VII-VIII MCS in 1249 and 1501 and VI-VII MCS in Mantua during the 1693 earthquake (see Fig. 6).

3. Situation at the three World Heritage properties

3.1 - Cathedral, Torre Civica and Piazza Grande, Modena

The property of the Cathedral, Torre Civica and Piazza Grande of Modena was inscribed on the World Heritage List in 1997, according to criteria (i), (ii), (iii) and (iv). The magnificent 12th-century cathedral, the work of two great artists (Lanfranco and Wiligelmus), is a supreme example of early Romanesque art. With its piazza and soaring tower, it testifies to the faith of its builders and the power of the Canossa dynasty who commissioned it. The area of the World Heritage property is relatively small with its 1,2 Ha. The buffer zone extends for 1,1 Ha.

During its history, the area of the property was affected by geotechnical subsidence due to induced vertical stress and related settlements; interaction among tensional states and related pressure bulbs below the foundation of Cathedral and Civic Tower (Ghirlandina); and more recently as a consequence of the lowering of the water table in the 1970s and '80s. These phenomena caused the leaning of the Civic Tower towards the Cathedral, which led to the establishment of a monitoring system.

The town of Modena is located 35-40 km from the epicentre of the main shock of 20 May 2012 (M=5.9 and depth 6.3 km) but only 25-30 km from the M=5.8 earthquake of 29 May 2012 which, however, had a deeper hypocentre (D=10.2 km). The physical impact of the earthquakes on the town was not very severe, in terms of damage to buildings and infrastructures (intensity V of Mercalli-Cancani-Sieberg scale). In general, such value corresponds to a vibratory ground motion felt inside by most people, which may causes furniture to move slightly, small objects to fall, and glass windows to break.

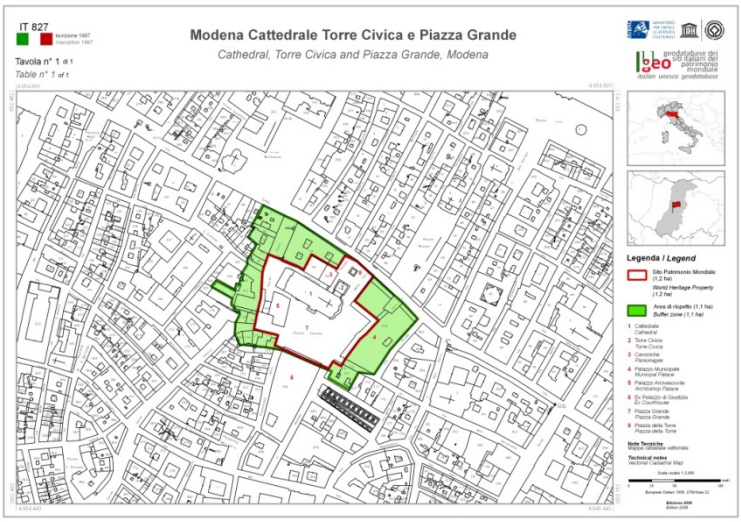

Fig 7. Map of the World Heritage property of the Cathedral, Torre Civica and Piazza Grande, Modena.

That the area is exposed to the risk of earthquake was well known in Modena at least since June 1501, when a well-documented major seismic event caused significant damage to numerous buildings in town, including the Cathedral and the Ghirlandina, as well as to another tower adjacent to the current City Hall, which had to be partially demolished and has been since named the "Torre Mozza" (Broken Tower). Recently, earthquakes hit the region in 1996 (intensity VII of the Mercalli-Cancani-Sieberg scale, with epicentre at some 25 km from Modena) and then again in the year 2000.

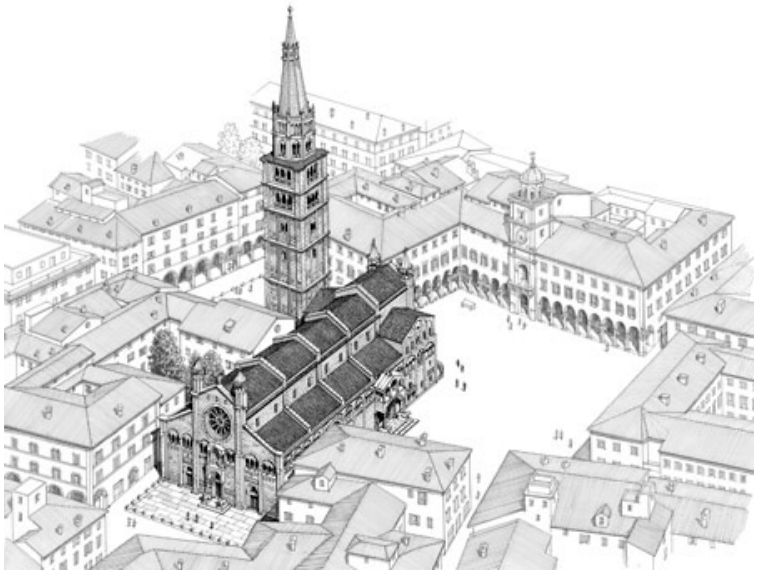

Figure 8 – A bird-eye view of the World Heritage property (copyright Loreno Confortini, www.lorenoconfortini.it)

As regards the damage caused by the latest earthquakes to the buildings located within the World Heritage property, the Mission noted some minor cracks on the bearing walls and vaults of the Cathedral, near the main entrance, often along old cracks that had been repaired. Two bricks have fallen off two of the ribs of the main vault, as well as mortar that had been used to repoint the old cracks. The deformation caused by the seismic event, measured by the existing monitoring system, was apparently of the order of a tenth of millimeter, thus almost negligible. Despite this, as a precautionary measure, the authorities had decided to transfer precious movable heritage items from the Cathedral to a safe storage place, to prevent any possible risk from other possible seismic events. No information was reported on occurred damage to the other buildings located within the World Heritage Property and its buffer zone.

Figure 9 - Bricks collapsed from the vault at the main entrance.

The experts of a permanent Advisory Committee on the Cathedral and the neighboring Tower of the Ghirlandina, who visited the site shortly after the Mission, considered that the structure of the Cathedral had resisted well to the earthquake, while no structural damage had been observed in the Ghirlandina Tower (with the exception of a crack on a sculpted bas-relief), very likely thanks to a recent restoration intervention, carried out following the above-mentioned earthquake of 1996. It should be noted that a restoration intervention is also underway on the facades of the south-eastern part of the Cathedral, where scaffoldings had been erected.

The experts from the permanent Advisory Committee stated that, as soon as the damage observed has been repaired, the Cathedral could have been fully re-opened to the public. For the time being, they recommended that only areas where no damage had been observed could have been opened for visitation. The possibility to verify instrumentally, and immediately, the impact of a vibratory ground motion on a monument, thanks to the monitoring system in place, was considered greatly beneficial.

3.2 - Ferrara, City of the Renaissance, and its Po Delta

The property of "Ferrara, City of the Renaissance and its Po Delta" includes:

- The historic city of Ferrara, inscribed in 1995 under cultural criteria (ii), (iv) and (vi) for its outstanding universal value "as a Renaissance city, remarkably planned, which has retained its urban fabric virtually intact";
- The "ducal residences" and the "planned cultural landscape" of the land reclamations surrounding the city along the Po River and its Delta, inscribed in 1999 as an extension of the former World Heritage property, under criteria (iii) and (v).

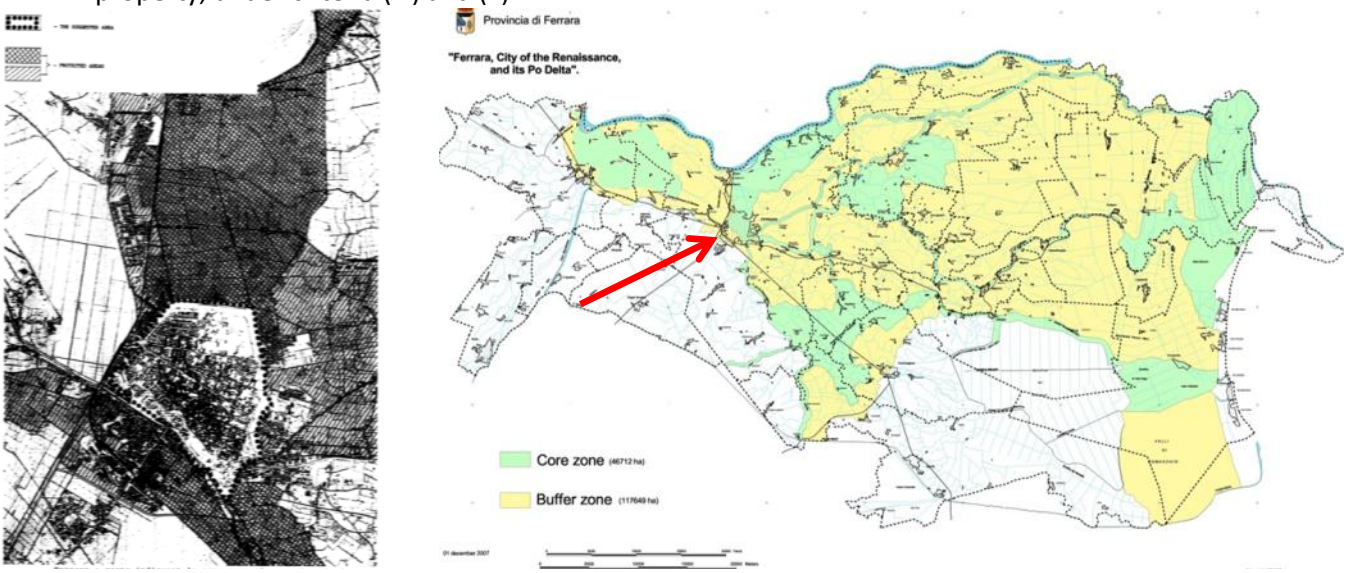

Figure 10 - Left: the property of the "Renaissance city", inscribed in 1995; right: the extension of the property of 1999. World Heritage property is shown in green, while buffer zone areas are in yellow. The red arrow indicates the position of Ferrara, whose historic centre is entirely included in the inscribed property.

The historic city and the western edge of the "cultural landscape" area are situated at a distance of about 15-20 km from the epicenter of the main shocks of the 20th of May (M=5,9). The impact on the World Heritage property has been considerable and was later increased by the numerous aftershocks of the following days that

affected already weakened structures. Surprisingly, the area of Ferrara had not been listed as exposed to seismic risk by national legislation until 2003, and only by 2005 regional bylaws were enforced to address low-moderate risks (rank 3) in the construction of new buildings and the adaptation of the existing ones.

The damage caused by the earthquake affected different attributes of the Outstanding Universal Value of the property – i.e. the monuments, the urban fabric and the landscape. Fortunately, however, the damage suffered by these buildings and structures does not appear to be irreversible. Out of the approximately 800 historic buildings protected by the national laws, based on initial observations, it appears that about 1/3 have suffered from non-destructive or minor damages. These include cracks on the bearing walls and vaults (often along previous ones), detachment of brick or stone elements and plasters from the facades, fall of parts of turrets, acroterions, chimneys and tiles. In particular, the following is worth to be reported:

Figure 11 - The two damaged lantern turrets of the Estense Castle of Ferrara (above) and the emergency works to fix the detached frescos (below)

- Two towers of the Estense Castle, undoubtedly the most important monument of the City, have been seriously endangered by the partial collapse of one of the lantern turret, and by the structural torsion of the other, which threatened to collapse. This adds to the possible worsening of cracks in the brick masonry and the initial detachment of some frescoes decorating the ducal residence. Initial works of consolidation and repair have immediately started but the museum and the visitors facilities were still closed at the time of the Mission;
- The medieval Cathedral presents minor cracks along the vertical structures of the transept and is currently opened with restrictions only for the Sunday mass. Also most of the churches punctuating the Renaissance urban fabric, including the ones designed by Biagio Rossetti like S. Cristoforo, S. Francesco, S. Maria in Vado, have been affected by various moderate structural damages, particularly corresponding to the facades and transepts, and are currently closed to the public;
- Several historic public buildings have been affected by serious structural damages in the medieval and early Renaissance urban fabric, and are currently considered totally or partially unfit for use and closed to the public. The integrity of Palazzo Paradiso (the first university buildings in the late 14th century currently accommodating the Biblioteca Ariostea) was put at risk by the torsion and the partial collapse of the turret surmounting the façade, which was soon disassembled; whilst the Renaissance palaces of the University (including the Rectorate and several Faculties) have been affected by various structural damages to the vertical structures and the vaults. In the "Addizione Erculea", the extension to the medieval city which dates from the renaissance period, the most critical situation concerns the Palazzo Massari which accommodates an important museum of modern and contemporary art;

Figure 12 - Left: the disassembled roof of the collapsed turret of Palazzo Paradiso,in Ferrara. Right: cracks on the façade of Palazzo Massari, which houses the civic modern and contemporary art gallery.

- The state of conservation of the City walls has been seriously affected, particularly in the southern section running along the former riverbed of the Po: the earthquake has worsened the critical situation of some fortifications, particularly the bastions of S.Pietro, S.Antonio and S.Lorenzo as well as the main gate to the City of Ferrara, known as the Porta Paola, which presents new dangerous structural cracks;

Figure 13 - Left: cracks on a southern bastion of the City Walls; right: cracks on Porta Paola

- The most worrying situation probably concerns the recently restored medieval Rocca (bastion) of Stellata, set along the bank of the river Po, 20Km from Ferrara and nearer to the epicenter, where the roof and the vaults sustaining the floors have moved with possible risks for the overall stability of the building.

As for the residential building stock of the historic urban fabric the situation is being checked on a case by case basis but the damages, even if minor, appear to be very widespread. In general, as per the protected heritage buildings, the damages are often associated with pre-existing cracks, lack of recent maintenance, weak foundation soil, sometimes the typology of past interventions.

Figure 14 - Structural damages in the Rocca of Stellata

A first assessment is still on-going at the time of writing of the present report, but from preliminary investigations it appears that the southern part of the historic city – i.e. the medieval – early Renaissance urban fabric by the ancient riverbed of the Po - has been most severely hit by the earthquakes. Up to 16 June, the Municipality of Ferrara and the Civil Defense had received by private owners and residents some 6300 requests of technical inspection to check the stability of the structures (around 70% in the Historic City). A first quick survey has been conducted on more than the half (3673) of these buildings and 2380 have been assessed as fit for use, whilst 1293 will have to be more thoroughly inspected and their use is bound to restrictions. This detailed survey has been so far conducted on 392 buildings, 48 of which have been declared by the authorities as unsafe. As a matter of fact, the conditions of many dwellings if not dangerous are certainly critical and 186 residents are currently resettled in different structures the city (unoccupied new buildings, hotels, guest houses).

The “cultural landscape” of the WH property has been also affected, particularly in the north-western area, near to the epicenter. Besides the Rocca of Stellata (see above), some rural settlements have suffered from serious structural damages and have been evacuated. East of Ferrara, only minor cracks have been observed in the ducal residence of Villa Mensa. However, the most dangerous impact concerns one of the two hydraulic systems that protect the city and the countryside from floods and droughts (the western one, which extends between the provinces of Modena and Ferrara). This has been affected by landslides along the embankment of the Canale Burana and, most of all, by damage to several service buildings, sometimes historic, which include locks, pumps and other equipment, which have been declared as unfit for use.

The initial response by the competent authorities, at all levels, has been prompt and efficient, aimed at providing conditions of security for the people and the most dangerous public structures and spaces. Immediately after the main shock of 20 May, emergency interventions were carried out to avoid the collapse of the lantern turrets of the Castle. These include the installation of propping, rings and tie-rods to prevent further collapses, the removal and storage of turrets, pinnacles and other elements at risk from the facades overlooking the public spaces, the stabilization of acroterions, chimneys and roof tiling, the creation of barriers along the streets and around the damaged buildings.

Figure 15 - Initial emergency works to stabilize or remove elements at risk of collapse

A close coordination has been established between the Municipality and the Civil Defense Department to carry out a first assessment of the damages to the building stock and implement the above emergency interventions, with the collaboration of professional bodies on a voluntary basis. In the case of heritage buildings, even if private residential, both of these institutions collaborate with the Superintendence and the Regional Directorate of the Ministry of Cultural Properties and Activities. This collaboration is a guarantee against destructive interventions that may easily occur in such a critical situation.

It has to be stressed that the above operations are being conducted by the above authorities in close consultation and collaboration with the different private and public stakeholders, which play an important role in the city's economic and social life (i.e. the University, the Dioceses, the Public Health agencies, and so on). However, the number of the structures to be checked represents a real challenge, also considering the limited financial and human resources currently available for the local government and the public bodies, and a realistic estimate of the cost of reconstruction is nowadays impossible.

As a result of the above, many public buildings and heritage properties (including most of the churches, museums and the theatre) have been closed to the public, pending the verification of their stability and the possible implementation of safety measures, while the end of the school year has been advanced. All teaching activities have been stopped at the University and the responsible authorities are already planning activities for the next academic in more restricted premises. Similarly, many commercial and professional activities have been stopped or reduced, while ppen air markets, festival and musical events which are very popular among the population and represent a tourist attraction have been postponed ore are at risk.

3.3 Mantua and Sabbioneta

Mantua and Sabbioneta is a serial property composed of two historic urban centres. Together, they represent two aspects of Renaissance town planning in the 15th and 16th centuries: Mantua shows the renewal and extension of an existing city, while 30 km away, Sabbioneta represents the implementation of the period's theories about planning the ideal city. Typically, Mantua's layout is irregular with regular parts showing different stages of its growth since the Roman period and includes many medieval edifices among them an 11th century rotunda and a Baroque theatre.

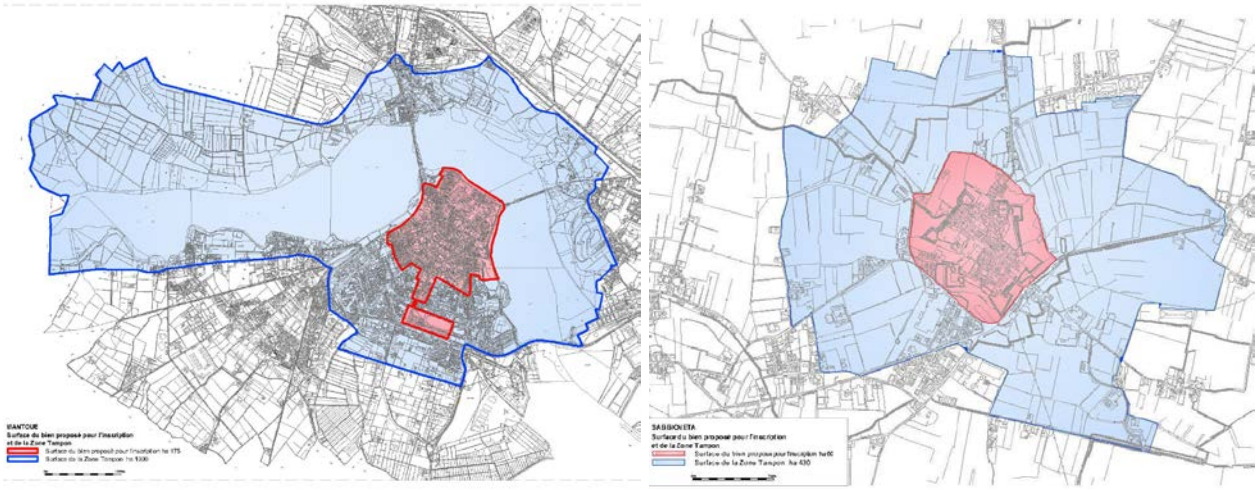

Figure 16 – Maps of the two components sites of the property (Mantua, left and Sabbioneta, right)

Sabbioneta, created in the second half of the 16th century under the rule of one person, Vespasiano Gonzaga Colonna, can be described as a single-period city and has a right angle grid layout. Both cities offer exceptional testimonies to the urban, architectural and artistic realizations of the Renaissance, linked through the visions and actions of the ruling Gonzaga family. The two towns are important for the value of their architecture and for their prominent role in the dissemination of Renaissance culture. The ideals of the Renaissance, fostered by the Gonzaga family, are present in the towns' morphology and architecture.

In Mantua and Sabbioneta, both seismic events of 20 and 29 May were strongly felt. As in Ferrara, numerous buildings have been affected by the earthquake, notably a large number of churches, and are currently being assessed for structural stability. A Crisis Unit was established on 30 May, chaired by the local Superintendent, to oversee the assessment of the damage and plan for the recovery.

The Mission started its visit in Mantua, at the Palazzo Ducale, which is also the seat of the local Superintendence. The most worrying situation concerned the lantern of the bell-tower of the Church of Santa Barbara, the chapel of the Palace, which had partially fallen on the underlying buildings and could collapse entirely if a new strong earthquake were to happen. Emergency consolidations interventions were being planned at the time of the visit by the Mission. In various other parts of the complex, which also houses an important Museum and remarkable frescoes, such as the famous "Camera degli sposi" by the celebrated renaissance artist Andrea Mantegna, cracks (both old and new) have appeared, and small fragments of decorations have fallen off.

Figure 17 – Above, the collapsed turret of the bell-tower, Church of Santa Barbara (Palazzo Ducale, Mantua). Below, fallen fragments of painted decoration (left) and safety measures within the galleries of the Museum (right).

The technicians of the Superintendence are carrying out the necessary safety measures (e.g. stabilization of chimneys, etc.)and verifications and are concerned by the possibility of new seismic shocks and their possible consequences on the buildings and the works of art that it contains, including an outstanding triptych by Cima da Conegliano. For this reason, some scaffolding have been installed to support the cracked false ceilings along one of the galleries of the Palace, while its paintings have been protected and sculpted busts laid on the ground as a precautionary measure.

In the Palazzo della Ragione, the greatest concern is related to the detachment of the south-western façade. Plans are being rapidly arranged for a temporary stabilization, pending consolidation works. For reasons of safety, the local weekly market which used to take place in the piazza in front of the Palace has been temporarily moved to another location. At the Palazzo Te, which was recently the subject of a careful intervention of restoration, the damage observed by the Mission was minimal, mostly consisting of the opening of very small cracks on the northern wing. Indeed, the Palace was re-opened to the public on the day of the visit by the Mission.

The Mission was not able to verify the state of conservation of the larger built stock within the historic city of Mantua, including residential, private buildings etc. However, the impression was that this had been less affected by the earthquake, compared to the city of Ferrara. Despite this, and as in Ferrara, the socio-economic impact of the earthquake on the City and its inhabitants was considerable. By way of example, the Mission was informed that 80% of all the bookins made by tourists for the month of June had been cancelled, as were all of the numerous cultural events that traditionally make of Mantua a particularly attractive destination in the summer period.

At Sabbioneta, some 30 KMs to the south-west of Mantua, an earthquake had actually happened already on 25 January 2012 (4.9 Richter scale), causing minor damage, but had been considered as an “exceptional event”. The shocks of 20 and 29 May have caused additional damage, consisting, once again, in the opening, or widening, of cracks and the fall of elements of the decoration. The Mission visited the local Palazzo Ducale, the annexed Galleria degli Antichi, which were open to visitors, and the Teatro all’Antica. The local technicians from the City of Sabbioneta had carried out initial emergency measures to prop doors and windows, notably in the Galleria degli Antichi, where the detachments of a portion of a damaged fresco will be possibly required. A well-conceived consolidation intervention had also been planned, and the related drawings shown to the Mission, which should ensure the stability of the structure in the future. As in Mantua, the impression was that residential buildings within the walled enclosure had not been particularly affected by the earthquake.

Figure 18 – Sabbioneta, Galleria degli Antichi. General view (left) and cracks over a window of the last bay (right).

4. Impact of the earthquakes on the socio-economic context within the three World Heritage properties

The impact of the earthquake on the socio-economic context at the three World Heritage properties is worth to be considered because it will probably determine the priorities in the planning and implementation of the rehabilitation interventions.

On the one hand, particularly in Ferrara and Mantua, the memory of the ancient seismic events was completely lost and this increased a comprehensible state of shock and anxiety. A sense of insecurity was very widespread and many left their homes and activities for days. Not only the schools, but also many industries and offices have also been temporarily closed, including those of the Municipality, which is causing major economic losses and the disruption of the life of the community. The closing of nearly all of the Churches and other major monuments, moreover, including the main Cathedrals of Modena and Ferrara and S. Andrea in Mantua, as well as the Castles of Mantua and Ferrara (the high place of the very popular local horse race called “Palio”, that had to be postponed), is having a negative psychological effect on the inhabitants, who consider these buildings as landmarks of their cities and symbols of their communities.

On the other hand, it became more and more apparent that the social and economic life of the cities will be heavily affected by the uncertain future of some essential services such as schools (which have to be made earthquake-safe before they can be re-opened), or cultural activities that play a fundamental role in the local economies. Particularly in Ferrara and Mantua, the temporary closing of the museums and the cancellation or the postponement of many cultural events and festivals of national importance is putting at risk the tourist season. Besides, particularly in Ferrara, the activities of many public and private administrations, as well as the University, are seriously hampered and have to be reorganized, pending the works of consolidation and adaptation of the structures.

Having said that, it should be also noted that the impact of the earthquake on the World Heritage properties has been of lesser gravity, if compared to that on the areas of the epicenters of the main shocks near the cities of Mirandola, Finale Emilia or Bondeno. Here, about 16.000 people still live in provisional tent settlements organized by the Civil Defense and the local authorities, while several thousand jobs are at risk due to the destructive damage suffered by industrial and agricultural infrastructure, which represent a significant part of the GNP.

Moreover, a widespread and extremely rich cultural heritage of historic centers, fortifications, palatial and vernacular architecture and rural settlements, which characterizes the landscape of the Po-River Plain, has undergone diffused and irreversible losses, whilst many remaining monuments or landmarks (i.e. the bell towers and the old industrial chimneys) are threatened of demolition to create conditions of security that may allow the inhabitants of the surrounding areas to return to their houses, and the resumption of local economic activities within the so-called “red zones”.

The post-earthquake reconstruction in these areas has become a national priority and the government’s economic measures reflect the need to recover as soon as possible an economic and social situation, which is made more difficult by the ongoing severe economic crisis and the shortage of financial resources. This will certainly affect the programs of interventions for the World Heritage properties, which can mainly rely on the competence and the dedication of the local administrative and technical bodies, depending on the Ministry of the Cultural Properties and the regional or municipal governments.

5. Response to the earthquake by the authorities

In terms of the response by the competent authorities, at all levels, these are at present doing their utmost, working around the clock in difficult conditions, to assess the damage and carry out emergency interventions. These have included localized propping, reinforcement rings of towers and the removal and storage in safe premises of items at risk from buildings, such as paintings or statues. The sheer number of the buildings and sites to control, however, is posing a real challenge, especially considering the risk of new seismic events and the limited staff and financial resources of the Ministry of Cultural Properties and Activities on the ground. Operations are being conducted in close consultation with the Municipal authorities and the Civil Defense Department (Protezione Civile).

One challenge will be to ensure that all initiatives within World Heritage properties are carried out within a coherent vision, given the complexity and fragmentation of the institutional framework that oversees their management, which includes the Ministry of Cultural Properties and Activities (with), City officials, the Church, a Consortium for Land Reclamation and many other governmental and non-governmental bodies, such as Universities and private cultural institutions.

As far as the Ministry of Cultural Properties and Activities is concerned, following the initial rapid checks and emergency measures, the local Superintendencies have started from 11 June a comprehensive and detailed assessment of the damage (through a dedicated GIS), using the standard forms in use by the Ministry of Cultural Properties and Activities (called AEDES) that also include the identification of the needed interventions of consolidation and rehabilitation and a preliminary cost estimate. This major effort, which will concern over 1300 heritage structures in the Emilia region, is coordinated by the central office of Bologna, and will enable in due time the planning and execution of consolidation and rehabilitation interventions.

Special funds will be allocated to this end, thanks also to a Presidential Decree issued on 8 June 2012, while staff from neighboring regions will be reassigned to the earthquake-hit areas to support their colleagues. With regard to the above-mentioned Presidential Decree, the Mission understands that this has been conceived primarily to enable, as quickly as possible, the re-establishment of the local productive infrastructure, by laying out a series of rapid procedures for its reconstruction. At the same time, the scope of the Decree includes the rehabilitation of much the historic and artistic heritage of the region.

In terms of institutional framework to manage disaster risks, in the days immediately following the earthquake, a National Coordination Unit for Emergencies was set up within the Ministry of Cultural Properties and Activities, to be activated in case of emergency. This will work in close cooperation with the Regional Directorates of the area where the disaster has occurred, where a dedicated Emergency Unit will be also established, which will have the task of coordinating with all other institutions operating on the ground, starting from the Civil Defense and the local authorities. In the case of the earthquake that has struck Emilia, a special expert Committee composed of three eminent structural engineers has ben also set up to advise on the most critical cases, for example bell-towers at risk of collapse which threaten surrounding buildings.

All of these new mechanisms, which add to the system already in place, should greatly enhance the capacity of the competent authorities to respond to disasters, once they have happened, and coordinate among themselves.

Less developed, on the other hand, appears to be the disaster risk *preparedness* for the three World Heritage properties, as reflected in the Nomination Files and Management Plans submitted by the State Party. The latter provide generic information on hydrogeological risks affecting the region and existing emergency plans at territorial level, but do not seem to include consideration of possible disaster scenarios, with the expected chain of causes and effects, that may affect the outstanding universal value of the properties, against all possible

hazards, nor specific provisions to mitigate or eliminate the related risks in a comprehensive way, that is, having in mind the overall World Heritage property.

6. Conclusions and Recommendations

In conclusion, the overall situation at the three World Heritage Properties, as concerns the state of the cultural heritage, is serious and characterized by widespread damage, although for the time being not catastrophic. No damage was reported, on the other hand, to the two sites included in the tentative List of Italy within the region affected by the earthquake, i.e. the "Porticoes of Bologna", in Bologna, and the "Scrovegni Chapel", in Padua. Severe damage, on the other hand, was noted in the areas surrounding the three World Heritage properties and nearer to the epicenters of the earthquake, including to rural structures that constituted important attributes of the cultural landscape of the Po River Plan.

In general, the Mission found that, wherever damage was observed, this was often associated with an inherent weakness of the building/site under consideration (due to pre-existing cracks, lack of recent maintenance, weak foundation soil, nature of past restoration interventions and even intrinsic fragility of buildings due to their original architectural design). Conversely, structures that had been well maintained and/or recently restored appear to have resisted well the seismic vibratory ground motion.

This suggests that, in the future, a comprehensive approach to a more effective disaster risk management – currently not specifically addressed in the Management Plans of the affected properties - may prevent or at least considerably mitigate possible damage from earthquakes or other hazards. This might require new and updated policies and regulations for building, conservation and maintenance that take into account earthquake risks, the establishment of emergency procedures for a wide range of disaster situations, based on scenarios that consider all possible hazards, and stronger coordination among all concerned institutions.

The response by the competent authorities appeared very timely and effective. The current effort will have to be supported through additional human and financial resources. In this respect, the recent Presidential Decree establishing fast procedures for the rehabilitation and allocating substantial resources over the coming three years is certainly necessary and welcome.

It would be important to ensure, in this respect, that any intervention on heritage properties and buildings constructed with traditional techniques within the perimeter of the World Heritage properties, be it a major monument or a simple residence in private ownership, is carried out according to accepted standards of conservation and in close consultation with the competent authorities, notably the local Superintendence of the Ministry of Cultural Properties and Activities. In this regard, adequate consideration should be given to traditional techniques, possibly to be integrated with modern retrofitting solutions, if and where necessary.

This will be critical to enable the appropriate conservation of a cultural heritage which, in addition to its intrinsic significance, is at least as vital for the long-term social and economic development of the region as is the industrial infrastructure.

The UNESCO World Heritage Centre will maintain contacts with the Italian authorities and follow closely the evolution of the situation on the ground. If requested from the Italian side, international experts could be mobilized, including through networks such as the ICOMOS International Scientific Committee on Risk Preparedness, the UNESCO Chair on Disaster Risk Management for Urban Heritage (Kyoto), ICCROM and other UNESCO partners, to support the work of the national and local authorities.

In the mid-term, UNESCO would be also happy to discuss with the Italian authorities strategies to better prepare to disaster risks World Heritage properties in the country as a whole. Considering the number and variety of the Italian World Heritage properties, the range of risks to which these properties are exposed, as well as the wealth of expertise available in the country in this area of work, this exercise could provide an opportunity to strengthen the disaster risk component of the management systems at all sites and at the same time develop useful case-studies and good practices that may be relevant to many other heritage sites worldwide.

ANNEX – List of Places Visited and Persons Met

The Mission was accompanied by Arch. Adele Cesi, From the World Heritage Unit at the Italian Ministry of Cultural properties and Activities.

7 June

Modena

The Mission visited the Palazzo del Comune (City Hall) and the Cathedral

Persons met:

HE the Mayor, Mr Giorgio Pighi

Arch. Rossella Cadignani, Historic Built Heritage, City of Modena

Ms. Francesca Piccinini, Coordinator UNESCO World Heritage property and Director Civic Art Museum, City of Modena

Don Giacomo Morandi, Vicar, Archbishopric of Modena

Don Orfeo Cavallini, Parish Priest

Eng. Mario Silvestri

Arch. Paola Grifoni

Arch. Graziella Polidori, Superintendence, Ministry of Cultural properties and Activities

Several members of the Scientific Committee for the Restoration of the Cathedral

Ferrara

Estense Castle (seat of the Superintendence and of the Museum)

Dr. Keoma Ambrogio, Superintendence for architectural and landscape heritage (Ministry of Cultural properties and Activities)

Mrs Manuela Paltrinieri, Capo di Gabinetto, Province of Ferrara,

Dr. Enrica Domenicali - Responsabile Ufficio Studi Gestione Museo del Castello, Province of Ferrara

Mrs Roberta Fusari –Councillor foro Urban Planning and building activities - City of Ferrara

Mr Aldo Modenesi - Councillor Public Works and Transportation - City of Ferrara

Eng. Luca Capozzi, Chief Eng. Head Public Works Department - City of Ferrara

Arch. Claudio Bignozzi , Cultural Heritage Unit - City of Ferrara

Dr. Arianna Zanelli - Coordinator UNESCO World Heritage property – City of Ferrara

Eng. Marco Magri, Deputy Head, Fire Brigades, Province of Ferrara

Cathedral of Ferrara

Eng. Don Stefano Zanella, Deputy Director, Cultural Heritage Unit, Diocese of Ferrara

City Theater:

Dr. Marino Pedroni, Art Director

Dr. Andrea Carletti, Stage Director

Dr. Marco Cazzola, Electrician

Dr. Cristiano Mantovani, Responsabile di sala

Palazzo Massari

Dr. Maria Luisa Pacelli, Director, Modern and Contemporary Art Gallery

Delizia della Diamantina

Enzo Cavallai - Owner

Rocca di Stellata

Architetto Moreno Po – Head, Provincial Planning Department, Province of Ferrara

Mantua and Sabbioneta

Ms Susanna Sassi – Coordinator UNESCO World Heritage property (City of Mantua)

Ms Mariangela Busi (City of Mantua)

Prof. Paola Falini – Heritage Consultant to the City of Mantua

Palazzo Ducale

HE Mr. Nicola Sodano – Mayor of Mantua

Dr. Giovanna Paolozzi Strozzi – Superintendent, Cultural Heritage for the Provinces of Mantua, Cremona and Brescia, Ministry of Cultural Properties and Activities

Mr. Stefano Loccaso – Director, Museum of Palazzo Ducale

Mons. Giancarlo Manzoli – In charge of cultural heritage, Diocese of Mantua

Ms. Daniela Lattanzi – Architectural Heritage Protection Unit – Regional Directorate of Lombardia

Mr. Antonio Giovanni Mazzeri – Superintenence, Provinces of Mantua, Cremona and Brescia

Mr. Giampaolo Benedini – Councillor, Public Works, City Quality, City of Mantua

Ms. Paola Menabò – Public Works Officer, City of Mantua

Mr. Vincenzo Chizzini – Councillor for Tourism - City of Mantua

Palazzo della Ragione

Mr. Carmine Mastromarino – Director, Dept. of Public Works – City of Mantua

Ms. Irma Pagliari – Director, Dept. of Cultural Activities, Tourism and City Promotion – City of Mantua

Palazzo Te

Mr. Stefano Benetti – Director, Civic Museums of the City of Mantua

Ms. Chiara Pisani – Conservator, Civic Museums of the City of Mantua

Sabbioneta

HE Mr. Marco Aroldi – Mayor of Sabbioneta

Mr. Giovanni Sartori – Councillor, Culture and Tourism, City of Sabbioneta

Ms. Raffaella Argenti – Head, Technical Unit, City of Sabbioneta

Mr. Andrea Marchini - Technical Unit, City of Sabbioneta

Don Massimo Morselli – Parish Priest, Sabbioneta (Diocese of Cremona)