Mantua Ducal Palace: One Year after the Earthquake. From Emergency Management to Seismic Improvement and Programmed Maintenance

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The earthquake that struck Emilia and Lombardy on 20th and 29th May 2012, seriously damaged the Ducal Palace in Mantua, pointing out a general vulnerability of the buildings and decorative settings of the Palace. As it often happens when important buildings are hit by calamities, the damages to Ducal Palace affected the whole town and surrounding territory: all the institutions and people involved in the restoration process were aware of the symbolic value of restorative measures and, at the same time, of the economic, touristic and image role of the Palace for the town. So they joined efforts to cooperate with very few economical resources. This report is about actions carried out in the first year after the earthquake: it describes damages, repairing works and operating programs by the Italian Ministry of Cultural Heritage (MIBAC) local departments as far as safety measures, structural reinforcements and building seismic improvement of Ducal Palace are concerned.

The earthquake has clearly showed a really critical, complex and serious situation and it is neither possible to delay interventions for integrated structural reinforcements in a short time period nor interventions for seismic improvement and programmed maintenance in a long time period. In particular, interventions are going to face the very difficult integration between structural reinforcement, restoration and conservation of the Palace, taking into account public use and heritage recreation of an extraordinary artistic and historical environment.

All actions and interventions already carried out or planned for the future are meant to manage transition from an emergency phase to a programmed improvement and maintenance phase, with constant monitoring, evaluation and seismic reinforcements of the buildings to better express aware and sustainable preservation of the cultural heritage for future generations.

1. Earthquake and Emergency Management

The image of “City within the City” perfectly suits the complex architectural, symbolical and historical relationship between Palace and Town. This image also concerns the surrounding area of Mantua (known as le Terre dei Gonzaga) meant as expression of the power of Gonzaga Family in the territory. The earthquake that struck Mantua on May 2012 has somehow retied the relationship of town, palace and surrounding territory in a period of sorrow. All the institutions and people involved in the emergency were in fact aware of the material and symbolic value of their work and, at the same time, of the economic, touristic and image role of the Palace for the town. The story of the Palace has been worked by the same features for the last
The Ducal Palace Layout

200 years: lack of funds and lack of integration of restoration and structural strengthening, which, due to the exceptional dimension of the buildings, is a serious drawback.

The earthquake showed how dramatic and critical the situation is: it is urgent in fact to carry out integrated safety measures, seismic programs and programmed maintenance actions to face the latent vulnerability which may damaged artistic heritage and people.
Two main facts are worth mentioning
- The very visible one, the collapse of the lantern of the bell tower of Santa
Barbara, the palace church, which came down on 29th May 2012 thus modifying Mantua’s skyline;
- and the quite invisible one, the little cracks in the walls of Mantegna’s Camera Picta, thus hardly visible but very dangerous, these superficial cracks show how vulnerable the most valuable treasures are.
The very first investigation of the spot showed the earthquake had generally worsened previous local instability caused by building interventions over the years.
Experts pointed out that in some cases damages mainly concerned decorative elements and that further light tremors may lead to the loss of important artistic material.
The most frequent damages of the buildings concerned the following items:
- structural elements: bearing walls, vault and ceilings, wall junction, bean and truss supports;
- independent architectural elements: wattle vault (cannicio), coffered ceilings, chimneys, balustrades;
- decorative elements: frames, decorations, stuccoes, frescoes, plaques;
- movable goods: statues, furniture, ceramics;
- warehouses: paintings and statues warehouse, archaeological warehouse.
The different part of the Palace (quarters) show the following damages:
- Corte Vecchia: this area does not show serious structural damages, cracks seen to be due to local stress typical of the peculiar shape of the building or architectural elements such a Volta dello Zodiaco or Sala dei Papi;
- Corte Nuova: serious deep vertical cracks damage Sala di Manto and Sala dei Capitani thus highlighting a critical structural issue due to the building discontinuity worsened by the quake. Structural instability is to be found in the Appartamento Grande di Castello and Rustica as well;
- Castello di San Giorgio: the Castello (one of the oldest building of the Ducale Palace) shows a complex crack pattern and a critical structural situation due to both local instability and building discontinuity. Deep cracks are to be found in the west tower (Sale delle Sigle) and in the connected structures. On the upper floor, the Carceri dei Martiri di Belfiore, is critically damaged by crack as well. The plaster of Camera Picta was cracked and paintings damaged so a very careful investigation and a preventive action to consolidate painting film were carried out.

2. Seismic Improvement and Programmed Maintenance
Opening part of the Palace to the public and planning actions for seismic improvement was considered extremely urgent and the following stages were therefore set:

**Stage 1** (June-December 2012): From emergency to normality
Urgent interventions and safety measures were carried out concerning both decorative elements and structural elements mainly as regards the Corte Vecchia.
The Visiting Tour of Corte Vecchia was reopened in September 2012, while all the other actions were duly completed by December 2012.

**Stage 2**: From emergency to enhancement
After the earthquake the Castello di San Giorgio and the Corte Nuova, the northern section of the Museum including Camera Picta, were closed.
The following steps are being planned and partially carried out to restore stability and enable reopening to tourists:
- Raising the safety level to meet requirements of SLA (Stato Limite dei Beni

The vault of Sala dello Zodiaco before and during reparation works
Artistic);  
- Testing and improving roofing and vulnerability; improving seismic measures through rigid roof flat surfaces and joints confinement;  
- Reducing vulnerability through actions concerning the main collapse mechanism, raising both local and general safety.  
The most important plans carried out by MIBAC concern works to improve safety and seismic measures of the North West Tower of Castello di San Giorgio where the famous Camera Picta is to be found.
The main objectives are the improvement of seismic response of the structures and the safe reopening of the premises to visitors. The programme is based on the structural interpretation of the buildings, the analysis of damages caused by the quake, the study of building interventions over the centuries and the analysis of earthquake damages in similar buildings (e.g. Finale Emilia Castle). The covering structures (roofing, merlots, attic) will be strengthened and tie rods will be set in the intermediate level to raise seismic response. All interventions will be carried out scientifically and so as not to affect artistic heritage. **Stage 3 (after 2014): from emergency to maintenance** Stage 3 is focused on defining seismic vulnerability within the buildings and setting up interventions of seismic improvement and programmed maintenance. The objective is to plan actions so as to be able to monitor, test and improve seismic response taking into account the importance of programmed maintenance and sustainable preservation of the cultural heritage for future generations.