

Work Package: Damage Analysis of Decorated Surface Structural Support by the Acoustic Emission Technique.

NUMBER: 2

TITLE: Damage Analysis of Decorated Surface Structural Support by the Acoustic Emission Technique.

RESPONSIBLE: GIUSEPPE LACIDOGNA

STARTING MONTH: 1

ENDING MONTH: 36

DESCRIPTION: The preservation of mural painting heritage is a complex problem that requires the use of innovative non-destructive investigation methodologies to assess the integrity of decorated artworks without altering their state of conservation. A complete diagnosis of crack pattern regarding not only the external decorated surface but also the internal support is of great importance due to the criticality of internal defects and damage phenomena, that may suddenly degenerate into irreversible failures.

A great deal of NDT techniques work by introducing some type of energy into the system to be analysed. On the contrary in AE tests, the energy input is the mechanical stress generated by the material itself during the damage evolution, so that no perturbation is induced and the integrity of the system could be guaranteed. By monitoring the support of a decorated surface by means of the AE technique, it becomes possible to detect the occurrence and evolution of surface vs. support separation and stress-induced cracks.

Cracking, in fact, is accompanied by the emission of elastic waves which propagate within the bulk of the material. These waves can be received and recorded by piezoelectric (PZT) transducers applied to the external surface of the artwork support.

The objective of WP2 is to use the AE technique to assess the support of the decorated mural surfaces in Piedmont developing the application aspects of this technique, which has been widely studied from a theoretical and experimental point of view by the research group led by Prof. Carpinteri and Arch. Lacidogna in the safeguard of civil and historical buildings. In a first stage, it will be essential to recognise the artwork to be monitored, its conservation state and the severity of its conditions at the beginning of the monitoring and restoration process. The AE technique makes it also possible to predict and localise the presence of cracks and analyse the damage evolution in supports such as decorated masonry walls and vaults.

At first, the research activity will focus on methods aimed at the localisation and quantification of the sources of acoustic emissions in the support of decorated surfaces. These highly advanced procedures, called Localization and Moment Tensor Analysis (MTA), are already used in seismology, where the seismic moment is a parameter directly correlated with fracture problems in the Earth's crust. To this purpose a computer-based procedure including the AE source location algorithm and the MTA will be implemented. These procedures will be performed by an automatic AE data processing software. The final output of the code will return a complete description of the decorated surface preservation state, giving precise information about the damage characterisation and evolution of the support stability. In addition, during the research activity in the most critical cases, or in some cases requiring prolonged in situ observation periods, the AE monitoring method will be fine tuned for the use of a telematic working procedure. Therefore, it is believed that huge structures could be monitored by means of sensors of a new type, using wireless transmission systems and efficient algorithms for processing large amounts of data. Thus, it will be possible to use a

centralised station to control continuously, simultaneously, and in real time, individual decorated surfaces, possibly situated in different sites.

Finally, because a correlation exists between the regional seismic activity and the AE signals collected during structural monitoring, the Acoustic Emission technique will be used for the preservation of decorated artworks from the seismic risk. In this framework the AE collected on structures sensor networks installed during the project activity in different monitored sites, will be directly connected to the “Centro Funzionale per la Previsione ed il Monitoraggio Ambientale del Piemonte”.

OBJECTIVES: Il WP n. 2 has the following main objectives:

- Revealing by means of the Acoustic Emission (AE) technique the damage evolution in the support of the decorated surfaces, which cannot be revealed by other investigation techniques.
- Supplying the AE equipment by wireless sensors for the telematic treatment of data and the remote control of artwork supports.
- Utilising the AE collected data coming from the in situ monitoring in order to preserve the artworks from seismic risk and eventual collapses due to earthquake actions.

ATTENDED RESULTS: The attended results from this WP particularly concern the following points:

- Defining a methodology which will allow the remote inspection of the bearing structures (supports) of decorated surfaces by the Acoustic Emission technique, with the aim of preventing cracking, damaging and detachments of materials, both in a stable or unstable regime.
- Preventing the reaching of critical condition of supports, also in case of exceptional events such as seismic activity and earthquakes.
- Utilising the Acoustic Emission technique as a system to prevent damage phenomena which may suddenly degenerate into the collapse of the whole decorated surface-bearing wall system.

Participant to the Work Package: Damage Analysis of Decorated Surface Structural Support by the Acoustic Emission Technique.

AGENCY PARTICIPANT: (Politecnico di Torino) DISTR

STARTING MONTH PEOPLE ACTIVITIES: 1

ENDING MONTH PEOPLE ACTIVITIES: 36

PEOPLE/HOURS ACTIVITIES FOR PARTICIPANT: 525

TOTAL PEOPLE/HOURS OF ACTIVITY Damage Analysis of Decorated Surface Structural Support by the Acoustic Emission Technique.: 525