Work Package: Analysis of debonding phenomena in decorated mural elements by numerical models based on Fracture Mechanics.

NUMBER: 5
TITLE: Analysis of debonding phenomena in decorated mural elements by numerical models based on Fracture Mechanics.
RESPONSIBLE: MARCO PAGGI
STARTING MONTH: 13
ENDING MONTH: 30
DESCRIPTION: The durability of junctions between materials with different elastic properties is an important problem non only in mechanical engineering, but also in civil engineering. In this field, in fact, the overall mechanical response, the phenomena of debonding and degradation, as well as the durability of plaster used to cover masonry walls and ceilings are strongly influenced by the mechanical compatibility of the constituent materials. In this context, the analysis methods typical of Fracture Mechanics can be profitably used in order to predict the occurrence of debonding phenomena and to establish design criteria useful for the choice of the repairing materials and for the preparation of the support.

In fact, the analytical and numerical methodologies of Fracture Mechanics permit to study the phenomena of debonding at the interface between layered composite materials, such as coatings and the base material. The analytical models based on Linear Elastic Fracture Mechanics permit to evaluate stress concentrations or even intensifications near the critical points where debonding takes place, such as the emerging points of bi-material interfaces on free surfaces or the tips of existing interface cracks. At the same time, the numerical methods based on Linear and Non-Linear Fracture Mechanics permit to study the problem of interface crack propagation and to investigate on the stability of interface cracks as a function of time, both in the case of monotonic and cyclic loading conditions.

Such methodologies have recently been applied by the research group coordinated by Prof. A. Carpinteri to the study of interface mechanical problems in heterogeneous materials. Among the most important studies performed in the past, we mention: the characterization of stress-singularities in multi-material wedges and junctions; the study of the stress field and the problem of delamination along the interface of multi-layered composite beams subjected to residual or thermo-elastic stresses due to a mismatch between the elastic properties of the constituent materials; the numerical analysis of the stability of crack propagation with a generic distribution of defects along an interface; the study of fatigue crack growth in multi-layered materials under repeated loadings.

In the present research, we propose an application of such methodologies to the study of debonding and damage phenomena in masonry walls with plasters or wall paintings, in order to assess the amount of damage and the durability of interfaces and to choose the proper rehabilitation technique to apply.

OBJECTIVES: The WP n. 5 has the following main targets:
- Analytical and numerical characterization of interface mechanical properties.
- Assessment of debonding and damage phenomena in masonry walls with plasters or wall paintings.
- Assessment of the durability of interfaces.

- Definition of an operative methodology for the choice of the proper rehabilitation technique to apply. **ATTENDED RESULTS:** - Setup of analytical and numerical methods for the study of debonding and damage phenomena in masonry walls with plasters or wall paintings.
- Definition of an operative methodology for the durability assessment of plasters and wall paintings and for the choice of the proper rehabilitation technique.
- Dissemination of the results at seminars and international conferences.
- Organization of an international conference at the Politecnico di Torino on the subject of the present research.

Participant to the Work Package: Analysis of debonding phenomena in decorated mural elements by numerical models based on Fracture Mechanics.

AGENCY PARTICIPANT: (Politecnico di Torino) DISTR
STARTING MONTH PEOPLE ACTIVITIES: 13
ENDING MONTH PEOPLE ACTIVITIES: 30
PEOPLE/HOURS ACTIVITIES FOR PARTICIPANT: 345

TOTAL PEOPLE/HOURS OF ACTIVITY Analysis of debonding phenomena in decorated mural elements by numerical models based on Fracture Mechanics.: 345