APPENDIX 1

MONUMENT MAPPING

The methodology of Decay mapping adopted in the study is based on the ‘Monument mapping method’ developed by Aachen University, Germany. The monument mapping method is approved as a well-experienced procedure contributing to reliable damage diagnosis at stone monuments (Stone, www.stone.rwth-aachen.de). This internationally accepted non-destructive method guarantees precise classification, registration, documentation and evaluation of stone types and degradation phenomena at natural stone monuments (Fitzner et al 1993, 1997; Fitzner and Heinrichs 1994, 1998). The method can be applied to all stone types and to all stone monuments. It provides detailed information on the entire stone surface of monuments. Special computer-programmes have been developed for processing, and illustration and quantitative evaluation of mapping information. Evaluation, quantification and rating of stone damages by means of monument mapping are based on objective description and registration of weathering forms according to type and intensity. By means of maps, all weathering forms get exactly located. Type, intensity and distribution of the weathering forms are evaluated as indicators for weathering processes and environmental impacts. Evaluation of weathering forms contributes to the assessment of weathering progression and to the calculation of weathering rates considering environmental situation, stone types as well as monument characteristics such as location, exposition, geometry and utilisation.
Weathering forms are used for detailed, objective and reproducible description of individual deterioration phenomena at mesoscale (cm to m) according to type and intensity. They represent the visible results of weathering processes which are initiated and controlled by weathering factors. Unlike petrographical classification schemes, a detailed classification scheme of weathering forms did not previously exist. The working group ‘Natural stones and weathering’ has developed such a detailed classification of weathering forms as the basis for precise, objective and reproducible registration and documentation. Components of the classification scheme are four levels of differentiation, definitions of weathering forms, symbols for registration and data processing, parameters for intensity classification of the weathering forms and a photo atlas. Recently, the classification scheme has been updated. Four groups of weathering forms are distinguished in the uppermost level I and as follows: group 1 – loss of stone material; group 2 – discoloration / deposits; group 3 – detachment; group 4 – fissures / deformation.

Based on defined schemes, all weathering forms are related to damage categories. The damage categories have been established in order to rate the different types of damage and as follows: Damage category 0 - no visible damage - Preservation measures are not necessary; Damage category 1-very slight damage- Preservation measures are not necessary; Damage category 2-slight damage–Preservation measures are not necessary, thorough monitoring / reevaluation is advisable; Damage category 3-moderate damage- Preservation measures are advisable, otherwise thorough monitoring / reevaluation is necessary; Damage category 4-severe damage-Preservation measures are necessary; Damage category 5-very severe damage-Preservation measures are necessary and urgent.
Damage indices have been introduced for conclusive quantification and rating of damage. Damage indices are calculated based on quantitative evaluation of damage categories. From a scientific point of view evaluation by means of weathering forms, damage categories and damage indices provide important information on: - weathering damage in dependence on lithotypes, environmental influences and monument exposure characteristics, - development of weathering damage, weathering rates / weathering progression, - factors and processes of stone weathering, - stone durability.

The consequent use of weathering forms, damage categories and damage indices allows manifold scientific and practical evaluation. It contributes essentially to the improvement of scientific knowledge in the field of stone weathering at monuments and to the development of weathering models. With respect to monument preservation practice, the results obtained from monument mapping represent an important contribution to deduction, test application and execution of efficient and economic monument preservation measures. The consequent use of weathering forms, damage categories and damage indices means a very suitable strategy for control / certification of preservation measures and for regular reevaluation of monuments in the framework of long-term survey and maintenance of monuments. The consistent evaluation strategy based on monument mapping can be recommended to organisations, monument authorities and monument owners involved in planning and decision making of monument preservation policies and strategies as well as to architects, engineers, restorers, conservators, consultants, project managers or construction companies involved in damage diagnosis and monument preservation activities.