

JURE RADIĆ
VLATKA RAJČIĆ
ROKO ŽARNIĆ

EDITORS

HERITAGE PROTECTION

CONSTRUCTION ASPECTS



INTERNATIONAL CONFERENCE
PROCEEDINGS



EUROPEAN CONSTRUCTION
TECHNOLOGY PLATFORM

Scientific Comitee

Jure Radić (chairman)	(Croatia)	Marjana Šijanec-Zavrl	(Slovenia)
Roko Žarnić (co-chairman)	(Slovenia)	Milos Drdacky	(Czech Rep.)
Božo Biskupić	(Croatia)	Wolfgang Kippes	(Austria)
Jelka Pirkovič	(Slovenia)	Giorgio Monti	(Italy)
Ferdinand Meder	(Croatia)	Juan Manuel Mieres	(Spain)
Michel Chapuis	(EC)	Svein Haagenrud	(Norway)
Dubravka Bjegović	(Croatia)	Andrè de Nayer	(Belgium)
Bojan Majes	(Slovenia)	Jan Rosvall	(Sweden)
Antonia Moropoulou	(Greece)	Dražen Aničić	(Croatia)
Christiane Maierhofer	(Germany)	György L. Balazs	(Hungary)
Mladen Obad-Ščitaroci	(Croatia)	Ludovit Fillo	(Slovakia)

Technical Editor

Vlatka Rajčić

This book contains 79 papers that were presented during the International Conference and Brokerage Event on HERITAGE PROTECTION-CONSTRUCTION ASPECTS that was held in Dubrovnik from 14-17 October 2006.

Conference and Brokerage Event Organizers were Structural Engineering Conferences (SECON) in cooperation with European Construction Technology Platform (ECTP), University of Zagreb, Faculty of Civil Engineering (GF) and University of Ljubljana, Faculty of Civil Engineering and Geodesy (FGG).

CIP - Katalogizacija u publikaciji
Nacionalna i sveučilišna knjižnica - Zagreb

UDK 72.025.3(063)
69.05(063)

INTERNATIONAL Conference Heritage Protection
- Construction Aspects (2006 ; Dubrovnik)
Heritage protection - Construction
aspects : proceedings of the International
Conference organized by SECON, European
Construction Technology Platform,
University of Zagreb and University of
Ljubljana, Dubrovnik, Croatia, October
14-17, 2006 / editors Jure Radić, Vlatka
Rajčić, Roko Žarnić. - Zagreb : Secon
HDGK, 2006.

ISBN 953-95428-1-2

I. Graditeljska baština -- Zaštita i revitalizacija

301002091

6. City and territorial aspects

72. Valorization of cultural heritage in sustainable development of Dubrovnik region. Modal analysis of features restricting the use of region components. 567
Šmit
73. Redistribution of Activities in Region to protect Dubrovnik Heritage 575
Šmit, Petrović, Krajnik
74. Conservation and sustainable maintenance of modern urban architecture 583
Meiling, Rosvall
- HL1 Education, training & Ethics**
75. Education and Training in Cultural Heritage: the Greek Experience 591
Moropoulou, Konstanti, Kokkinos
- HL2 Technical Standards and Specification** 599
76. Durability aspects in new Croatian standard
Radić, Mandić, Kindij
- HL3 Preservation of artworks** 607
77. PaperTreat - Preserving our paper based collections
Kolar, Strlič, Lojewski, Havermans, Steemers, Knight, Palm, Hanus, Perminova, Nguyen, Porck, Lussenet
- HL4 Socio-Economic Aspects**
- HL5 Disaster Prevention and Risk Management**
78. Earthquake protection of historical buildings by reversible mixed technologies - The PROHITECH research project. 611
Mazzolani
- HL6 Communication and Dissemination**
79. Geomonumental routes: A useful tool for popularizing the built heritage 623
Alvarez, Perez-Monserrat, Fort



CONFERENCE AND BROKERAGE EVENT
THE CONSTRUCTION ASPECTS OF BUILT HERITAGE
PROTECTION
Dubrovnik, Croatia, 14 – 17 October 2006

GEOMONUMENTAL ROUTES: A USEFUL TOOL FOR POPULARIZING THE BUILT HERITAGE

M. Alvarez*, E. Perez-Monserrat* & R. Fort*

*Institute of Economic Geology
Spanish National Research Council-Complutense University of Madrid, Spain

Key words: geomonumental route, geology, heritage popularization, dissemination, preservation, conservation, education, management

Abstract: *The Geomonumental Routes entail a new proposal for the popularization of architectural heritage based on the geological materials that have shaped it, their behaviour and decay and how to preserve them. These routes take into account both social and scientific perspectives, being a novel method for the knowledge, transfer and preservation of architectural legacy. The prefix «Geo» highlights the link between geology and monuments, as any human urban settlement is conditioned by the geology for its placement; also the main resources for building are extracted from the Earth. The role of the stone within the built heritage confers a major value to it, and by itself. A better knowledge of stone as a building material accounts for a different way of preserving and valuing built heritage.*

Geomonumental Routes take visitors on a journey from the surrounding area to the inside of the monument. These Routes focus on aspects such as the building history of monuments, the construction materials and their sources, the location of the historical quarries, the conservation/deterioration condition in which the monuments are, and any past restoration work performed in them.

To date, the Institute of Economic Geology has developed six Geomonumental Routes in the Region of Madrid. These Routes are also very useful for bringing a great stimulus to the architectural heritage which is less known and therefore less valued, such as traditional architecture which is usually excluded from tourist itineraries. Valuing heritage and recognising the need of preserving it, will contribute to awake more consciences towards the fact that sensitivity to inherited culture is a question of time.



EUROPEAN CONSTRUCTION
TECHNOLOGY PLATFORM



Structural Engineering
Conferences



University of Zagreb
Faculty of Civil Engineering



University of Ljubljana
Faculty of Civil and
Geodetic Engineering

1. INTRODUCTION

The Council of Europe launched the "Cultural Routes" programme in 1987 for revitalising European cultural heritage. In 1994 at the meeting "Routes as part of o(Madrid) organised by ICOMOS and the Spanish Ministry of Culture, the concept of a heritage route was defined. In 1998, the Council of Europe set up the European Institute of Cultural Routes for the task of monitoring the Cultural Routes programme as a whole. On the other side, UNESCO contemplates projects ("Routes of Dialogue") based on themed itineraries for cultural tourism which revitalise little known heritage sites. Nevertheless, none of these organisations currently contemplate the Geomonumental Routes proposed in this study.

A multitude of itineraries related to tourism, culture and heritage in different European countries appear in numerous publications and on websites. Their typology is as varied as is the diversity of heritage. The itineraries available may focus on such elements as architecture, museums, gastronomy, botany, geotourism (the prefix *geo* linked to geography), music, literature, history or art.

The creation of geological itineraries within cities for educational purposes is not new and still be relatively common^{1,2,3,4,5,6} with the clear intention of introducing architectural heritage from the perspective of construction materials and their conservation.

The method for popularizing information concerning architectural heritage proposed in this study has only just begun. We need to focus our efforts and attention on the Geomonumental Routes project as a means of raising public awareness of our architectural heritage, and of the geological sciences and scientific research associated with it. It is important that this type of route is offered as one cultural route more.

2. PHILOSOPHY OF GEOMONUMENTAL ROUTES

In raising awareness of architectural heritage from a historical and scientific perspective Geomonumental Routes foster the interaction between such disciplines as history, geology, chemistry, art, architecture and sociology.

Conveying the concept of how landscape forms part of the character of towns and villages is also an aspect of cultural heritage. The prefix *geo* indicates the strong geological influences that condition the location of urban settlements and their development. Geomorphology, hydrogeology, the presence of mineral resources and fertile soils, potential seismic and/or volcanic risks or the stability of the land have historically been factors which have influenced both the choice of areas on which to develop settlements and the classification of land use.

Stone has been one of the most pre-eminent materials for construction, but it does not last forever. As soon as it is exposed to the elements it interacts with its surroundings and begins to deteriorate. Geomonumental Routes are also concerned with the state of conservation of stone materials that form part of the architectural heritage. The study of building materials can give us a wealth of information on the quarries from which the materials came, the methods for extracting and transporting them, and the building and conservation techniques in use at that particular time. With respect to the industrial heritage of each period of history, such information forms an essential part of our patrimony. Conservation of architectural heritage is essential because monuments are the best document and testimony to the historical events that have taken place within their walls, where the relationship between the material and the architectural project can best be appreciated. Geomonumental Routes also herald a new concept in tourism. They make the visitor realize that architectural heritage is not only something to be admired from an artistic and historical viewpoint but that it involves many more added values.

3. GEOMONUMENTAL ROUTES IN THE COMMUNITY OF MADRID

Up to date, the Institute of Economic Geology has created six Geomonumental Routes, which appear on the Heritage section of the R&D Madrid's website, www.madrimasd.org/cienciaysociedad/patrimonio/rutas/geomonumentales/default.asp (Fig. 1).



Figure 1: Presentation webpage of the Geomonumental routes

Two of the routes are focused on single buildings, other two on monumental complexes, one more is a route through the traditional building stones used in the monuments of Madrid, and, the last one, an itinerary around the historic quarries of the region. Two more routes are in progress. The intention is to compile an Atlas of Geomonumental Routes in the Community of Madrid which, as it develops, allows the monuments to be consulted by topic, using a more scientific approach. One of the aims of these routes is to concentrate more on the promotion of less-known features of architectural heritage, including the traditional architecture of the region; its value is inestimable and its recuperation is becoming more and more necessary in view of the alarming rate at which it is being lost through the progressive neglect it has suffered in recent years.

4. DESIGNING A GEOMONUMENTAL ROUTE

4.1. Preliminary

The first essential for the creation of Geomonumental Routes as a new method of disseminating architectural heritage is an understanding and appreciation of the existing heritage. Raising awareness of heritage requires an analysis of the needs of the population, their links to it and the role they play in its development. At the same time, it is necessary to monitor any initiatives undertaken, as well as the impact these have⁷. The visitor to the Route should be made aware in advance of how architectural heritage forms part of the surroundings; in inviting him to make its acquaintance his interest is awakened. As a Geomonumental Route is primarily concerned with architectural heritage, it is necessary to establish the level of knowledge and interest regarding particular architectural typologies, construction materials, architects or different periods of construction. If this information is properly dealt with the most attractive elements, can be incorporated in the Geomonumental Route and will help to guarantee its acceptance and success.

As well as the age, sex and level of education of possible visitors, other aspects relating to geography, the type of site, its function, or links to certain occupations should be taken into account. Something that is near at hand or visually outstanding, or maintaining its original function, or related in any way to one's profession is going to hold more interest. All this is conditioned by two subjective factors: the sense of belonging and the sentimental value that a particular building or monument may evoke. We are more likely to value, and want to preserve and get to know something that we feel to be ours. Apart from the material sense of belonging, studies preliminary to the creation of Geomonumental Routes should analyse how the local population feels about architectural heritage forming part of their living space, and how this may be impoverished if it were to disappear. The sentimental value society confers on a monument is fundamental when analysing its opinion and finding out how initiatives and work carried out on its architectural heritage are perceived. The extent of this emotion is influenced by a variety of factors, such as the level of education, proximity to the building, its grandeur, or people's feelings about their roots^{7,8}. In addition, specialist opinion should be analysed. This is of utmost importance because the main responsibility for disseminating heritage lies with public institutions, and it is these that should promote and give impetus to Geomonumental Routes. Likewise, strategies for communication and information involving society should be developed, and understanding and sensitivity towards heritage should be encouraged at all levels of education. The Internet has a vital role to play here with its huge potential for transmitting knowledge. Institutions responsible for raising public awareness of heritage should aim to help society understand the function of historic sites within the context of a cultural whole, ranging from the past through to the future. It is essential to nurture communication between institutions and society and ensure that the criteria adopted are in accordance with the needs of the people, and that they are applied taking popular feeling into account. Equally, it is important to keep people informed about initiatives either planned or already put into practice, and encourage them to take part in them⁷.

4.2. Aspects to consider

Guidelines should be drawn up for Geomonumental Routes which serve to orient the visitor, offering different features but leaving the choice to him, so that he may go up to the monuments and feel free to look at them. They should teach him how to observe, and arouse his curiosity so that he can appreciate the close relationship between geology and architectural heritage. The significance and philosophy of Geomonumental Routes should be explained by means of a brief introduction aimed at disseminating and understanding architectural heritage, its revitalisation and conservation.

The first part, which is common, should include general aspects regarding the formation and extraction of geological materials, the changes they undergo, and the causes of their deterioration. The second part deals with those aspects that are peculiar to the elements included. The general aspects already mentioned can be developed further if need be, depending on architectonic elements and the area where the route is located. Data of interest include the names of buildings, architects responsible and dates of construction, the original function of a building, any changes in its use and its present use, as well as any historical account related to it that may be of interest. The particular topics dealt with on this part of the Geomonumental Route are:

Geological materials used: these may be stone, bricks, mortar, patinas, ceramic materials, each with a particular function and location. An explanation is given of the formation of the different varieties of stone found in the monument and/or the raw materials used in the manufacture of mortars, ceramic materials or outer facings. With regard to stone quarrying, attention is given to the dimensions of the stone, the cutting and finishing processes and the tools used, and, in the case of brick manufacture, to the size and positioning of the pieces as well as the differences in texture that can be seen. Graphic information on the visual and petrographic characteristics of the materials is shown, so that, their behaviour and suitability for construction can be better understood.

Sources of geological material: also considered are the geological formations from which the building stone is extracted and/or the raw materials used in the manufacture of other materials. The areas of exploitation, either abandoned or still active, are indicated, and attention is given to extraction processes and the influence on the development of transport routes in the area. The manufacturing process of materials such as bricks and ceramics may be included, and aspects relating to the technological development of such processes pointed out. For Routes in a rural environment the influence of geomorphology on the shape of centres of population and of the climate with regard to architectonic layout can also be included. Likewise, maps showing the direct source of geological materials can be shown.

Changes in the materials: physio-chemical changes occur in geological materials due to environmental factors and the position of the monument, which lead to their deterioration. Determining the petrographic and petrophysical properties gives an understanding of the internal structure of the materials, the way the mechanisms of change operate and the causes of deterioration. Moreover, if data obtained are compared, it will be understood why some are more susceptible to change than others, or how deterioration is conditioned by their position. It is also important to look at stone materials directly at the quarry, or where they outcrop, to be able to contrast the amount of degradation in materials coming into contact with atmospheric agents observed in monuments along the Route.

Work undertaken: this comprises work related to conservation, restoration and/or refurbishment that has taken place since the building was constructed. Such interventions will be pointed out and assessed, taking into account the building criteria that prevailed at the time. Any effects they may have had on the construction materials, either beneficial or detrimental, will be analysed. The need to conserve and maintain historic sites can be emphasised at this juncture, and any appropriate conservation work that may need doing pointed out. Although these Routes champion conservation and popularization rather than restoration, drawing attention to the state of historic sites and monuments in this way may motivate the appropriate institutions to undertake work on them.

Once information from observing the monuments and identifying their geological materials is acquired, the Geomonumental Route should contemplate a section where all the architectonic elements studied can be brought together, and conclusions drawn about the relationships between them. Such information will show, for instance, if the same typology of stone is present, whether different varieties can be identified within the lithology, the possible sources of geological materials, the main pathologies affecting the characteristics of the rocks, and the identification of different stages in construction or any subsequent work that has been undertaken.

4.3. Methodology

A Geomonumental Route can provide a wealth of information and it is essential that this is presented as attractively as possible. Through the use of simple language, the asking of questions and plenty of graphic information, it should let the visitor make the choices while at the same time stimulating his interest. The information can be presented either physically or virtually. A physical Route permits direct observation of the site, its setting, its materials and their changes over time and can supply physical aids and support. Because of its instructive and communicative character, this method is considered the most educational. The main disadvantages for the visitor are possible limitations in time and space and the difficulty of interconnecting with other routes. Virtual Geomonumental Routes would be websites that allow the visitor to enter into different topics related to the Route and have access to numerous features and activities connected with it. With the use of new technologies information can be presented in an attractive and eye-catching way, and can be easily modified. In this way the Routes can make use of other heritage trails (cultural or natural), which in turn can benefit from the Routes, something that has been taken into account in the compilation of the Atlas of Geomonumental Routes. The main disadvantage is that they do not allow the visitor direct contact with the monument and its materials. Visitor should get to know and value architectural heritage in situ and be able to touch it and observe it at close hand. One proposal for consideration is the creation of virtual Routes designed to attract the visitor's attention in such a way that he will want to experience them physically.

5. CONCLUSIONS

Time and natural processes have a relentless effect on architectural heritage, which has been partially lost and partially altered. Therefore, conservation must be defended and revitalisation becomes its driving force. To this end, public awareness and a special sensitivity towards heritage and its conservation on the part of society are fundamental. It is vital that this is reinforced through education. Only if we know our architectural heritage will we be able to value it, defend it and want it to be preserved. Suitable ways of transmitting information must be sought through public and/or private institutions, and one such way is through Geomonumental Routes. What is new about this type of route is the popularization of architectural heritage, based on the construction materials that have shaped it and the bringing of science and research related to it into the popular domain. Geomonumental Routes can be created and set up using routes than already exist, so that, the same elements can be linked from very different viewpoints and at the same time serve as a teaching and educational tool.

The implementation of this type of Route is an example to be followed on anywhere via the appropriate institutions. In this way, respect and appreciation for what is new and different will also be achieved. Europe's architectural heritage will be promoted worldwide at the same time as hitherto unknown heritages become better known in Europe. With its clear objectives and the necessary means, this novel initiative is considered to be not only feasible but necessary. The idea is to draw up an Atlas of Geomonumental Routes - an essential document for collective memory - and create virtual networks to link elements and/or group them together under different topics.

Valuing what is old and recognising the need for its preservation are aspects that are relatively recent, and awakening more consciences to show sensitivity towards inherited culture is a question of time. Given our training and opportunities the responsibility for educating to preserve the architectonic legacy that has been passed down to us lies firmly in our hands.

6. ACKNOWLEDGMENTS

We would like to thank the Regional Government of Madrid for the financial support through MATERNAS project (0505/MAT/94, Durability and conservation of natural traditional materials from the Architectural Heritage). Thanks are given also to the Ministry of Education and Science for a *Ramón y Cajal* Research Contract (MA).



REFERENCES

- [1] Anguita, F., San Miguel, M., Sánchez, J.R. (1982) Un itinerario geológico urbano en las inmediaciones del museo Nacional de Ciencias Naturales, Madrid. II Simposio Nacional sobre la enseñanza de la Geología, Gijón, España, 165-175.
- [2] Slagle, E.S. 1982. A Tour Guide to Building Stones of New Orleans, New Orleans Geol. Society, 68 p.
- [3] Doe, B.R. 1989. A different view of stone monuments, memorials and buildings of Washington, D.C.: 28th International Geological Congress Field Trip Guidebook T235, American Geological Union, 9 p.
- [4] Fort, R., Mingarro, F., López Azcona, M.C., Álvarez de Buergo, M. 1996. Restauración y rehabilitación en monumentos emblemáticos de Alcalá de Henares. Itinerarios Geológicos desde Alcalá de Henares, ed. Universidad de Alcalá de Henares, Congreso Geológico Alcalá de Henares, Madrid, España.
- [5] U.S. Geological Survey, 1998, Building stones of our Nation's Capital: Washington, D.C., U.S. Geological Survey, U.S. Govt. Printing Office, 36 p. (written by Charles Withington and edited by Don Olson) <http://pubs.usgs.gov/gip/stones/tour.html>
- [6] Gaffikin, P. 1999. Set in stone: a geological guide to the building stones of Belfast. Environment and Heritage Service, Belfast.
- [7] Benítez de Lugo, L., Ibáñez, J., Rodríguez, E. 1994. Determinación de estrategias para la mejora de la rentabilidad social del Patrimonio Histórico de la Comunidad de Madrid. Asociación Contexto, Madrid, España.
- [8] McKercher, B., Ho, P.S.Y., du Cros, H. 2005. Relationship between tourism and cultural heritage management: evidence from Hong Kong. *Tourism Management*, 26(4): 539-548.