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Day 1 - November 18th, Monday

Room Rogers - Conservation and management

P.M. Koufopoulos & M. Myriantheos *The master plan for Wadi El Deir, Sinai Egypt: research and interventions*

M. Wu, S. Hu, Z. Xue, C. Shi *Monitoring and maintenance of built heritage within the daily management system: a case study of world cultural heritage Suzhou classic gardens in China*

L. De Marco, G. Franco, A. Magrini *Guidelines for eco-efficiency in the UNESCO site of Cinque Terre: an example of best practice*

A. Cazzani & C. Sangiorgio *Inventory, preservation and valorization of Historic roads In the Lombardy Region (Italy). Current policies and future plans*


S. Pratali Maffei & A. Marin *Forte Marghera and the entrenched field of Venice: a participatory process of planning and valorization*

R. Picone *Farmhouses in the Phlegrean Fields between archaeology and architectural palimpsest. A multi-disciplinary approach*

C.F. Carocci & C. Circo *“Needs-based architecture” in the Cyclades. A project for the enhancement and conservation of the architectural heritage and the rural landscape*

F. Colosi, R. Gabrielli, E.S. Malinverni, R. Orazi *Strategies and technologies for the knowledge, conservation and enhancement of a great historical settlement: Chan Chan, Perù*

E. Ciocchini, A. Maiocchi, F. Zangheri *The chapel of the Blessed Virgin of Miracles: a multidisciplinary approach for the project of conservation and reuse*

D. Concas, G. De Cesare, G. Capri *Santa Teresa from convent cloistered nuns to ‘open’ museum for the community*

C. Carocci, F. Campisi, I. Tranchina *The medieval Castle of Fossa (AQ). Analysis and restoration project*

I. Huic, M. Vujasinović, M.O. Šćitaroci *St. Mary on Lastre church in Beram, Istria, Croatia -multidisciplinary research, recommendations for restoration and further maintenance*

S. Dandria, F. Gabbrigli, M. Giamello, E. Giorgi, A. Magrini, E. Manzoni, F. Randazzo
Grancia of Cuna: from the complexity of the historical building to a composed knowledge for the project

G. Cardani & L. Binda Guidelines for the masonry quality evaluation in built heritage

E. Bersani, M. Giambruno, S. Pistidda Planning for the historic built in developing countries: challenges and opportunities through the case study of Multan (Pakistan)

M. Faliva New York City Local Law 11/98: consequences of administrative regulations on the conservation of buildings

K. Penna, E.S. Taylor, J.L. Tinoco From paper to people: the complexities of developing guidelines for preservation education in developing countries

Room IV - ICT and new technologies

F. Fassi, C. Achille, C. Monti, L. Fregonese, S. Parri, F. Rechichi, A. Mandelli, C. Monti, F. Gaudio, L. Galbusera A yard of the future: the main spire of Milan Cathedral

C. Pisu, P. Casu, S.M. Grillo Multidisciplinary approach to the documentation of the XVIII century marble altars in Sardinia

G. Fangi Spherical photogrammetry for cultural heritage metric documentation: a critical examen six years after the beginning

L. Pecchioli, F. Mohamed, M. Pucci, B. Mazzei Museum of the sculptures of the basilica of Saint Silvestro integrating the visit at the catacombs of Priscilla in Rome


V. Palieraki, C.E. Adami, E. Vintzileou In-situ measurements using radar and boroscopy techniques: Case Study - Hagia Sophia Museum of Trabzon, Turkey

Telmo Dias Pereira & D. Mateus Monitoring noise and vibration emissions in Santa Clara-a-Velha Monastery

L. Giorgi & P. Matracchi The towers of San Gimignano. Architectural diagnostic for knowledge and conservation

V. Russo, P. Cappelletti, G. Ceniccola, M. D’Amore, R. Landolfo, F. Portioli Interdisciplinary conservation issues of an “unstable” architecture: researches about the bell tower of St. Augustine the Greater in Naples

C. Giannico, A. Ferretti, S. Alberti Satellite Radar interferometry: a new monitoring tool for cultural heritage sites
A. Furini, M. Paternò, A. Pellegrinelli, P. Russo Integrated measurement techniques for the monitoring of the ancient walls of Ferrara

A. M. Manferdini Documenting lost heritage. The experience of the survey of architectures damaged by the earthquake in the Emilia area, Italy

J. Barton & R. Parsons Use of leading edge Laser scanning and modelling technologies for Heritage conservation

V. Bayarri, E. Castillo, J.M. García-Moncó, J. Calonge Diez Integration of traditional and innovative techniques to resolve a complex case: monitoring the movement and temperature influence of the canvas in the south transept of the Church of the Convent of San Luis in San Vicente de la Barquera (Cantabria)

A. Lionello, C. Rossi, P.P. Rossi Testing and monitoring for the control of strengthening interventions of Santa Maria Gloriosa dei Frari in Venice

E. Coisson & F. Ottoni Monitoring historical structures, from their past to their future

Room G.2 - Materials, preventive conservation and maintenance

S. Sestini, M. Sammartino, M. Laurenzi Tabasso Monitoring the performance of stone conservation treatments: technical and economic aspects

E. Tesser, L. Lazzarini, R. Ganzerla, F. Antonelli The decay of silicone resins applied for the consolidation of stone in Venice

G. Bearman, E. Doehne, L. Beegle, W. Hug, R. Reid, R. Bhartia Remote Detection of Biofilms on Stone

S. Sasso, L. Scrano, E. Ventrella, M.G. Bonomo, A. Crescenzi, G. Salzano, S.A. Bufo Natural biocides to prevent the microbial growth on cultural heritage

A. Velosa, F. Rocha, A. Haugen Mortars in Norway from the Middle Ages to the 20th Century: conservation strategy


P. Ortiz, R. Ortiz, J.M. Martin, M.A. Vázquez RIVUPH: an Andalusian project for risk analysis in historical cities

R. Vecchiattini, G.L. Pesce, G. Quarta, L. Calcagnile Sampling problems in the radiocarbon dating of old mortars and plasters with the “pure lime lumps” technique

G. Litti, A. Audenaert, J. Braet, L. Lauriks Energy environmental monitoring in historical
buildings; a simplified methodology for modeling realistic retrofitting scenarios. The case study of Schoonselhof Kasteel in Antwerp (Belgium)

J. Sasaki, K. Koizumi, D. Ogura, T. Ishizaki, K. Hidaka Research project on the conservation of Hagia Sophia, Istanbul - results of environmental monitoring

R. Hendrickx, H. De Clercq, F. Decock, F. Descamps Hygrothermal analysis of the façades of the former veterinary school in Anderlecht (Belgium) for the risk assessment of internal thermal insulation

A. Caratelli, A.M. Siani, G.R. Casale, A. Paravicini, C. Bertolin, D. Camuffo Indoor measurements of microclimate parameters in the Mithraeum in the Baths of Caracalla (Rome, Italy)

H. Norrström The EEPOCH Project - Multidisciplinarity in a multiple case study

I. Papayianni, M. Stefanidou, V. Pachta Survey of repaired and artificial stone at archaeological site of Pella five years after restoration works

D. Gulotta, C. Tedeschi, S. Goidanich Long-term evaluation of the salt decay susceptibility of NHL repair mortars

A. Calia, D. Liberatore, N. Masini Approach to the study of conservation of historical masonry mortars by means of the correlation between porosimetry and penetrometric test. First results

Poster Session A
E. de Almeida Historic Center of Salvador, Bahia, Brazil: dilemma between conservation and cultural consumption

Balayet Hossain Historical imprints of Panam Nagar

T. Basirico & K.B. Fazio A multidisciplinary approach to the sustainable restoration of historical buildings: the case study of the San Francesco ex-convent in Piazza Armerina in Italy

J.N. Bastos The Algarve XVI-Th century Rural House – intervention for survival

J.N. Bastos The Fortress of Sagres (Portugal) - an heritage and restoration practice

J. Bruin et al. Uncovering mono-functional developments in a Seventeenth-century canal-zone block in the Canal District of Amsterdam World Heritage

S. Bruni et al. Post-earthquake recovery of architectural heritage: diagnostics, GIS documentation and restoration
G. Buyukmîhcî & A. Ozkan *Integrity of conservation and sustainability techniques in a special historic site*

P. Chiodi et al. *A multidisciplinary approach: the conservation of an ancient bridge over the greater Zab river as part of community development plan of Deralok hydropower project under japanese international cooperation agency loan*

V. Cinieri & E. Zamperini *Lifecycle oriented approach for sustainable preservation of historical built heritage*

S. Colombo *An application of memory studies to museology: the case of Pinacoteca Ambrosiana between 1960s and 1990s*

F. Converti *The technological innovation of the knowledge areas: The Tourist Board of the City of Peastum*

T. Dreyfuss et al. *Transmitting Malta’s legacy of forts and fortifications through the reuse of an abandoned 16th century warehouse*

R. Fabbri & S. Ciliani *For the valorization of the Monumental UNESCO Heritage: the system of signs pedestrian tourism in Ferrara and Modena*

B. Ferri & A. Maturo *Built cultural heritage and urban development: elements for a cultural planning in Pescara city*

C. Gentile et al. *Diagnostics and preservation strategies applied to historic iron infrastructures: the Paderno arch bridge (1889)*

P. Giandebiaggi & C. Vernizzi *The Roman amphitheater in Durres: the survey as a means of multidisciplinary knowledge for urban regeneration, architectural recovery and archaeological excavation*

K. Keutgens & B. Delmotte *Study of the architectural history of the St. Martin’s Church, Zaventem, Flanders, by means of preliminary material-technical research*

C. Mura *Knowledge of modern architectural heritage in Sardinia through construction techniques. The case of rural architecture of Arborea (OR)*

B. Davidde Petriaggi et al. *The restoration of the Domus of the Mithraeum of the Painted Walls (Ostia): a methodological approach*

S. Sadeghi *A concealed garden: critical view on the restoration of Ghasr Prison, Tehran, Iran*

G. Sanfilippo et al. *A systemic approach for the restoration project: the church of St. Anna in Piazza Armerina (EN)*
G. Verdiani et al. *Ad impossibilia nemo tenetur. Three case studies on built heritage elements at risk*

M.R. Vitale et al. *Methods and strategies for the ‘sustainability of the ancient built-up: studies and preliminary analysis on the “Monte” quarter in Piazza Armerina*

**Day 2 - November 19th, Tuesday**

**Room Rogers - Conservation and management**

M. Landoni *Conservation project on Nandin hall at Vat Phou archaeological site (Laos PDR)*

J. Cassar, S. Cefai, M. Galea, R. Grima, K. Stroud, A. Torpiano *Preserving the Megalithic Temples of Malta - the interdisciplinary approach*

R. Buzancic *Restoration of Diocletian’s mausoleum in Split*

G. Bagnasco Gianni, S. Bortolotto, P. Favino, A. Garzulino, M. Marzullo, E. Riva, R. Simonelli, S. Valtolina, A. Zerboni *Past&Present at Tarchna & Tarquinia: a flexible approach to make visible the invisible*

W. Terlikowski & P.L. Narloch *Specificity of research and reconstructions of ancient wall constructions in Syria, the area of Palmyra*

P. Pesaresi *The Herculaneum Conservation Project’s programmed maintenance cycles for the archaeological site of Herculaneum*

D. Cavezzali & A. Giovagnoli *Conservation works of the Hall of Masks in the Domus Aurea, Rome*

G. Putaturo *Restoration of the Villa Reale of Monza*

P.N. Barrera & P.E. Bartholomew *Anthropology of Design: how traditional Korean architecture is redefining the terms of conservation, collaboration, and sustainable management*

A. Baila, L. Mazza, A. Anzani *Conservation and restoration of polychrome stone mosaics in the architectures of the historical park of Villa Tatti Tallacchini: the music pavilion - Cafe house*

T.L. Park *The process surrounding the preservation of historical wooden architecture in Japan*

F. Ottoni, F. Aureli, C. Mambriani, P. Mignosa *An integrated conservation process between history and hydraulics. The case of the ancient masonry “Tower of waters” in Colorno, Parma*
M. Borsotti & C. Campanella *An architectural project for existing buildings from understanding to writing*

M. Carlessi & A. Kluzer *Past, present and future of the forgotten places in the ancient “Ospedale Maggiore” (Ca’ Granda) in Milan. Studies, surveys, analysis, prospects and projects*

A.C. Glória *The “private” cultural heritage: management, right and public fruition. The case of Cedovim manor’s house (Vila Nova de Foz Côa, Portugal)*

**Room IV - ICT and new technologies**


S. Bortolotto, A. Castiglioni, A. Castiglioni, N. Cattaneo, S. Massa *Complex Archaeological Sites: An integrated stratigraphic framework for progressive knowledge acquisition and representation*

A. Versaci, A. Cardaci, D. Indelicato, L. Fauzia *Integrated survey methodologies for the knowledge, restoration and valorization of modern architecture. The case study of the archaeological museum of Siracusa designed by Franco Minissi*

G. Bearman, E. Doehne, J. Voss, K. Merrill, R. Bagaria *Citizen Science and Mobile Phone cameras as tools for monitoring World Heritage*

T.E. Boothby *Ars sine scientia: how incorrect design theories lead to correct designs*

S. Arangio, S. Molinaro, F. Bontempi *Basic modeling for the forensic investigation of the collapse of a masonry structure*

K. Papadopoulos & E. Vintzileou *The new ‘poles and empolia’ for the columns of the ancient greek temple of Apollo*

Epikourios M. Vasic, D. Coronelli, C. Poggi *A multidisciplinary approach for the assessment of great historical structures: ties of “Duomo di Milano”*

S. Arangio, F. Bucchi, F Bontempi *Pushover seismic analysis of masonry buildings with different commercial codes*

B. Benedetti & S. Montanari *Methodology and technology in two new museums in Saudi Arabia*

M. Negrini & N. Di Blas *Digital storytelling for Cultural Heritage: a modular, multi-channel, multi-scenario approach*

G. D’Amico, A. Del Bimbo, A. Ferracani, L. Landucci, D. Pezzatini *Onna project: a na-
tural interaction installation and mobile solution for cultural heritage

M. Barcaro & E. Oliviero Scrigno, enriching the visitor’s experience with a tablet

Room G.2 - Materials, preventive conservation and maintenance
C. Pasquarella, C. Balocco, E. Marmonti, G. Petrone, G. Pasquariello, R. Albertini An integrated approach to the preventive conservation of cultural heritage: Computational Fluid Dynamics application


E. Rosina & E. Rotta Environmental protection and control systems for architectural and archaeological heritage

A. Bonazza, I. Natali, I. Ozga, G. Bartolozzi, C. Cucci, V. Marchiafava, M. Picollo Pollution effects on typical Florentine lithotypes: a multidisciplinary approach


S. Lugli, S. Minghelli, P. Zannini Barium silicate consolidation of historical sandstones

V. Tornari & A. Moropoulou Crack micromorphology detection in stone samples by digital holographic speckle pattern interferometry

L. Brizi & P. Fantazzini Internal structure of porous media studied by the apparent water self-diffusion coefficient in the field gradient of a portable single-sided NMR instrument


M. Rossetto Capillary rising damp in historical buildings: electrophysical charge neutralization technology - a needful “zero impact” instrument to prevent and resolve the problem once and for all

A. Goppion, A. Gioria, G. Cotrufo Museology meets conservation: Goppion displaycases with multiple microclimate

A. Bernardi, F. Becherini, A. Vivarelli, C. Ghiretti, E. Mendez Bertolo, L. Pockelé, M.D. Romero-Sanchez, N. Tellado, R. Wansdronk Application of innovative technologies for energy storage to Cultural Heritage buildings
M. Filippi, M. Rota, P. Picchi *The accreditation process for Museums in Regione Piemonte. Preventive conservation and indoor environment monitoring*

A. Grimoldi, D. Del Curto, A. Landi, C. Manfredi, L. Valisi *From rest/cons to en/eff: indoor environment and building preservation*

L. de Santoli, C. Calice, V. Coccia, V. Fazio *Multidisciplinary approach for renewal of historical center: the case study of Ceglie Messapica (BR)*

**Poster Session B**

F. Agnello & R. Prescia *Integrated studies for the enhancement of complex historic monuments*

W. Bagiński *Using location-related knowledge to maintain a historic residence*

V. Bayarri-Cayón et E. Castillo *New processing tools for heritage conservation and documentation*

N. Benabdellkader & M. Morandotti *The historical site of Mansourah*

R. Cacciotti et al. *MONDIS Knowledge-based system: application of semantic web technologies to built heritage*

I. Cerato et al. *From the dig to 3D reconstruction and AR dissemination. The case study of the Roman kiln of Massa (IT)*

S. Karaman et al. *MNEMOSYNE: visual profiling for personalized cultural content delivery*

G. Leucci et al. *The Foggia Cathedral: an in situ integrated geophysical and mechanical study on the wooden structures of the ceiling*

M.F. Mancini et al. *From video sequence as a database for the generation of 3D models to video as a tool for architecture communication*

S. Pallara & C. Caiulo *Energy saving for historical heritage: the domotised lighting system of the Cathedral of Nardò (Lecce - Italy)*

B. De Roo et al. *Conservation of past times: data models for ensuring the future of our heritage*

I. Rubino *Step by step: exploring heritage through a mobile augmented reality application at Palazzo Madama - Museo Civico d’Arte Antica (Turin, Italy)*

E. Sassoni & C. Mazzotti *Assessment of masonry mortar compressive strength by double punch test: the influence of mortar porosity*
G.M. Ventimiglia Role of diagnostic surveys in the conservation of the former mother-church of Santa Margherita di Belice in Sicily: preliminary tests and restoration site checks

S. Zambruno et al. Photographing the past: using cloud computing and photo-modeling for 3D historical architecture modelling

Dav 3 - November 20th, Wednesday

Room Rogers - Conservation and management
A. Saisi, M. Guidobaldi, C. Gentile, L. Cantini Dynamic and seismic assessment of the Gabbia tower in Mantua, Italy

I. Stoyanova Promoting a Nineteenth-century Italian Technology: the Crystal Skies of the Milanese Gallery “Vittorio Emanuele II”

G. Vella & E. Messina Fruition and valorization of disused manufacturing settlements: the “tonnare” of the Gulf of Castellammare case-studies


Y. Salman, Z. Önsel Atala, N.B. Yöney A model for an integrated multi-disciplinary approach for the preservation of 20th Century and modernist architectural Heritage

R. Lozano Galvez The multidisciplinarity in the protection of the 20th Century architectural patrimony

P. Dellavedova Instruments for the preservation and promotion of the 20th century built heritage: the case study of Legnano (MI)

D. Sarti & L. Varra The organization of a districtual museum: the Textile Museum of Prato between the preservation of an industrial heritage and the development of a sustainable system

E. Invernizzi & M.M. Locatelli Central Karakorum National Park and the Northern Areas territory: the “Cultural Heritage Routes” Project

N. Berlucchi A fortress for Brescia: the enhancement of the Castle and the Cidneo Hill

K. Rajangam & P. Modi Nakshay - a community led culture mapping initiative an attempt towards best practices and successful conservation

sciplinary researches

P. Gasparoli & A.T. Ronchi Crespi d’Adda. Beyond the Management Plan: regulatory instruments for the management of built heritage transformations

M. Achenza, I. Giovagnorio, L.G.F. Cannas The ‘earthen cities’ itinerary

J. Bruin et al. Knowledge is Power: Monitoring the World Heritage site of Amsterdam, a policy analysis

K. Rajangam & P. Modi Heritage information management package (himp) -technology and experience driven approach towards efficiently managing India’s built heritage sites

Room IV - ICT and new technologies
S. Hermon, F. Niccolucci, K. Yiakoupi, A. Kolosova, G. Iannone, M. Faka, P. Kyriacou, V. Niccolucci Documenting architectonic Heritage in conflict areas. The case of Agia Marina Church, Derynia, Cyprus

L. Guerriero, S. Barba, E. De Feo, F. Fiorillo, A. Manco Multidisciplinary analysis: the early christian complex in Cimitile (Italy)

G. Verdiani, A. Peruzzi, M. Gualandi The Piacenza Cathedral, from the digital survey to a complete multimedia documentation

N. Masini, F. Gabellone, G. Leucci, R. Persico, F. Soldovieri Enhancement of the information content available from non invasive diagnostics for restoration and knowledge of architectural heritage

C.F. Carocci & A. Scudero The restoration project of the church of Saint Agata in Tusillo (AQ, Italy) within the framework of the post-earthquake reconstruction plan

M. Dolce, E. Speranza, R. Dalla Negra, M. Zuppiroli, F. Bocchi Constructive features and seismic vulnerability of historic centres through the rapid assessment of historic building stocks. The experience of Ferrara, Italy

R. Fabbri Complex monumental heritage: problems and operational programs for post seismic restoration

A.G. Mazzeri Mantua Ducal Palace: one year after the earthquake. From emergency management to seismic improvement and programmed maintenance

K. Nedvědová & R. Pergl Cultural Heritage and floods

F. Niccolucci, A. Felicetti, N. Amico, A. D’Andrea Quality control in the production of 3D documentation of monuments
G. Guidi, P. Rodríguez Navarro, S. Gonizzi Barsanti, L.L. Micoli, M. Russo *Quick textured mesh generation in Cultural Heritage digitization*

P. Ronzino, F. Niccolucci, A. D’Andrea *Built Heritage metadata schemas and the integration of architectural datasets using CIDOC-CRM*

E. Demetrescu, G. Lucci Baldassarri, A. Pagano, S. Pescarin *CONNEXT: CONNECTing metadata to web3D interactive applications of large archaeological contexts*

M. Riggio, J. Sandak, A. Sandak, I. Santoni, L. Babinski *Degradation of wooden surfaces in historical buildings: integrated sensing and modeling techniques for monitoring and conservation*

M.S. Okten, C. Haydaroglu, B.B. Okten *A structural design case study on reconstruction of a historical timber mansion*

V. Sousa, T. Dias Pereira, D. Silva *Asset management of built heritage: application to wood-framing elements of the National Palace of Sintra, Portugal*

**Room G.2 - Materials, preventive conservation and maintenance**

L. Brambilla, P. Condoleo, S. Perego, G. Zerbi, L. Binda *Experimental study on the influence of the environment on the properties of vegetal resins used in the conservation of Cham temples in Vietnam*

A. Verganelaki, N. Maravelaki, V. Kilikoglou, I. Karatasios, I. Arampatzis, K. Siamos *Synthesis and characterization of a calcium oxalate-silica nano-composite for stone conservation*

G. Cappelletti, P. Fermo, A. Piazzalunga, G. Padeletti *Transparent hybrid films for stone preventive conservation*

T. Dreyfuss & J. Cassar *Ammonium oxalate treatment application in the presence of soluble salts: laboratory results on soft limestone*

M. Matteini, C. Colombo, G. Botticelli, M. Casati, C. Conti, R. Negrotti, E. Possenti, M. Realini *Ammonium phosphates to consolidate carbonatic stone materials: an inorganic mineral treatment greatly promising*

E. Sassoni & E. Franzoni *Evaluation of hydroxyapatite effects in marble consolidation and behaviour towards thermal weathering*


S. Tamburini, M. Favaro, A. Magro, E. Garbin, M. Panizza, F. Nardon, M.R. Valluzzi *Geopolymers as strengthening materials for Built Heritage*
R.S. Adhikari, E. Lucchi, V. Pracchi *Historical buildings: energy performance and enhancement*

M. Legnér & A. Luciani *The historical indoor climate. A long-term approach to conservation environments within heritage buildings*

F. Romano, M. Gaudenzi, C.M. Joppolo, L.P. Romano *Temperature and humidity in museum display case: a simulation tool and experimental validation*

G. Cavaglià, M. Mangosio, I. Caltabiano, C. Curti *Intervention strategies for the energy retrofit of the built heritage: a case study in Turin*

**Poster session C**

A. Alomari et al. *Experimental study on the role of freezing-thawing in the degradation of stones in the castle of Chambord*

P. De Berardinis et al. *Strategies for improving energy of the historic masonries of the minor centres of Abruzzo Region*

A. Bonazza et al. *Climate impact and innovative materials for the preservation of Built Heritage: the EC NANOMATCH project*

C. Conti et al. *First results on diethyl oxalate as a new product for the conservation of carbonatic substrates*

M. Coppola et al. *Analysis and conservation of ancient Egyptian gypsum-based binders and mortars from the temple of Ramesses II in Antinoe*

G. Corso et al. *Pigments and binders in Pompeian four styles wall paintings*

C. Daffara et al. *The challenge of infrared imaging of frescos: thermal quasi-reflectography unveils hidden features of artworks*

E. Galán & P. Aparicio *The environmental risk assessment applied to cultural heritage. A methodological approach*

M. Jadicicco Spignese & Z. Faravelli *Historical buildings current value*

C. Kyi et al. *Investigations into the suitability of the free radical molecule nitric oxide (NO•) in the treatment and control of biodeterioration*

E. Lombardi et al. *Strategies for increasing the scale of biocleaning treatment through sulfate crust bioremoval*

T. Meier et al. *Ultrasonic surface measurements for the investigation of superficial*
alteration of natural stones

A. Osman & J. Kościuk Characterization of binding lime mortar used in the ruins of Anba Bishoi Monastery near Sohag (Egypt)

M. Pretelli et al. Indoor Microclimate effect on heritage buildings: the case study of Malatestiana Library

A. Proto et al. Ca-based absorbents for NOx measurement in atmospheric environments surrounding monumental and archeological sites

M. Stella et al. Testing of nanostructured products for the protection and consolidation of biocalcarenite

R. Terra et al. Restoration of San Petronio Basilica: four year project between innovation and eco-sustainability

D. Vandevoorde et al. Influence of environmental conditions on water adsorption measurements performed by non-destructive in situ applicable techniques

C. Kapridaki & N. Maravelaki TiO$_2$ -SiO$_2$ -PDMS nano-composite with self-cleaning properties for stone protection and consolidation

C. Zambella et al. Environmental monitoring of the St. Gennaro and St. Gaudioso catacombs in Naples
Strategies and technologies for the knowledge, conservation and enhancement of a great historical settlement: Chan Chan, Perù

Francesca Colosi¹; Roberto Gabrielli¹; Eva Savina Malinverni²; Roberto Orazi³

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1. Introduction

The Italian Mission in Peru (MIPE) has been working on the archaeological site of Chan Chan from 2002 in collaboration with the Ministerio de Cultura of Peru. The first task it was the documentation and restoration of Palazzo Rivero, the smallest and the most recent of the great monumental enclosures that characterizes the ancient town, with the aim of both studying the organization and function of this specific type of architecture and to expand the touristic area of the archaeological site. Soon, however, we realized that the problems related to the archaeological complex are varied and it is not possible to address the issue of the conservation and enhancement of a single monument without considering all the elements that compose the urban structure and the surrounding territory. In fact, although it is inscribed in the UNESCO World Heritage List, Chan Chan is suffering from a structural deterioration due to its building technique (mud brick or adobe), but also from an equally dangerous degradation due to the rapid urban growth of the nearby town of Trujillo and to migratory movements, still difficult to control.

In an attempt to stop the degradation of the complex, the Peruvian government, pressed by UNESCO, in 2000 approved the Plan Maestro de conservación y manejo del Complejo Arqueologico Chan Chan, redact by Instituto Nacional de Cultura, (today Ministerio de Cultura). The Plan Maestro has a number of projects and sub-projects aimed to enhancing the complex and its territory with the purpose of helping the socio-economic development of the population. The MIPE intends to support the actions foreseen by the Plan Maestro participating to its revision and updating and following three main objectives: the planning of the Archaeological Park of Chan Chan, the restoration and the virtual visit of Palacio Rivero and other peculiar architectonic typologies and the baking of local handicraft and tourism by mean of training courses arranged also with the help of the international cooperation. In order to achieve these objectives, taking into account the impressive dimensions of the site, it was very important to take advantage of the potentiality of new methodologies of investigation: the remote sensing techniques and the ICT processes to organize and archive the geodatabase; the modern acquisition techniques, such as laser scanner, to arrange a 3D surveying, to reconstruct in virtual way the emergencies and by means other multimedia solutions to spread the whole site by virtual visits.

In the paper, after a first part devoted to the description of the site, we will illustrate the work of the MIPE in relation to the above-listed objectives, describing the results achieved and the future prospects of research and planning.
2. The archaeological complex and its territory

2.1 The urban structure

Chan Chan, the greatest settlement of Latin America built in adobe, was founded during the IX century A.D. and represents the most important material expression of the Chimu culture, one of the various civilizations that arose along the northern coast of Peru before the Incas conquest (1475). The town occupies a very large area of the Moche valley, at about 600 km north of Lima, and it is placed on a natural terrace that decreases towards the ocean (from 40 to 20 m above the sea level) (Fig.1).

The agriculture was the main source of sustenance and its diffusion was assured by a highly developed irrigation system. A series of channel transversely connected the various rivers that from the mountains flow into the Pacific Sea and distributed the water to the fields, winning the desert and bringing prosperity and wellness.

At the height of its expansion the city spread over 20 Km2, out of which only 14 Km2 are preserved today. Of these, 6 Km2 belong to the urban zone, where nine palaces or ciudadelas were built, as well as numerous semi monumental complexes, known as elite compounds, five huacas or temples in the form of stepped pyramids and four extensive popular quarters constructed with a building technique named quincha, which consists in a mixture of mud on a structure of reeds and wooden posts [Moseley, Kent 1982; Kolata A.L., 1990, 107-144; Campana Delgado 2006].

The traces of the strong relationship between the town and its territory are still recognizable in a network of very long and pedestrian paths, often elevated and still in use, which allowed the functional distribution of the urban settlement and connected the town with the sacred areas, the cultivated fields and the huachaques.

These last are sunken fields near the sea that, exploiting the natural depressions of the terrain, are fed directly by the subsoil humidity (at the bottom in Fig.1). In the huachaques the campesinos cultivated the totora, a typical reed...
used for the constructions and for the fabrication of mats, baskets and small boats.

2.2 State of conservation
As mentioned above, the structures of Chan Chan have been suffering a continuous deterioration in these last centuries, due to human and natural factors. From the colonial period some “Companies for the exploitation of the Huacas” were founded and regulated with a Royal Decree in 1570. The “legal” work was then flanked by the huaqueros or grave robbers (still at work), while other damages are deriving from an uncontrolled agricultural activity inside and outside the palaces.

For what is regarding the natural factors, the main dangers are represented by the salts which are affecting the walls of Chan Chan and by the phenomenon of “el Niño”, a warming of ocean currents that produces high evaporation and very heavy rainfall.

At the territorial level, a very big problem is represented by the uncontrolled growth of the nearby city of Trujillo. The economy of Peru, which in recent years has been characterized by an increase of approximately 6% concentrated around the major urban centres, has caused the displacement of the inhabitants from the remote villages of the sierra and selva to the urban suburbs. A series of abusive agglomeration named pueblos jovenes were formed, without any type of service such as running water or the collection of garbage. In the area between Trujillo and Chan Chan the pueblos jovenes are in contact with the perimeter of the archaeological area, especially along the north and north east part of the complex.

3. Territorial analysis and GIS
The process of conducting an archaeological survey as investigative method, is dependent upon context. It requires the ability to accurately record field observations and their geographic location. Recent technological innovations in GIS, satellite imagery and mobile technologies have allowed for greater precision and efficiency in reporting. This part of the research presents the integration of GIS technology with archaeological survey. The GIS data arrangement, aided by different type of data processing, has allowed, during the research, to obtain a dedicated cataloguing to manage the data for the publication of different products, multimedia too. The improvement of the GIS data stored has allowed additional analysis, to retrieve new information about environmental and human settlements, discovering the relationships with the other heritage goods close to the site, increasingly the knowledge of themselves and introducing these information to the community of visitors.

The method for collecting data has been determined by a variety of factors, which can be chosen to balance the necessity to identify accurately the archaeological elements but also to make efficient and satisfactory the survey of the site. To take into account the intensity and the extent of a wide archaeological area it was necessary to organize the survey in units which can be natural field boundaries, roads, terraces, changes in vegetation, building ruins and so on. Not always it was easy to establish survey units on the ground. When
the time changes the aspect of the territory and the site is wide it is difficult to reconstruct accurately irregular units into a mosaic of coverages. The aerial photogrammetric surveying, made of Harvard University (Moseley, Kent 1982) (Figure 1, on the right) and the updated knowledge by the Quickbird image have been an important aid to guide the surveying on field and to recognize some archaeological emergencies. The different coverages have been organized in GIS layers with attributes. First of all the Amortiguamiento and the Intangible define the boundaries of the archaeological area and hold its presences. Following the Caminos localize, when it is possible, the ancient paths (roads), sometimes sacral, useful to analyze and understand the dynamic of growth of the different urban structures of the ciudadela. The hard work has been the surveying (till in updating), by a mobile DGPS, of many Estructuras arqueologica characterized by different uses. The list includes: Huachaques, Cementerio, Barrios Populares, Plataformas, Palacios, Residencias Elite, Huacas (Fig.2).

3.1 GIS documentation augmented by virtual visits
To increase the possibility to explore the heritage site in each aspect, we also realized some hyperlinks in the GIS, to retrieve the summarized knowledge of the Chan Chan structures, coming from the Master Plan (Plan Maestro) documentation, approved by the Peruvian Government in the year 2000. This descriptive report sheets give a short description of the different aspects of the site, useful not only to the experts but also to have an overview for all the visitors (Figure 3). Another opportunity in the GIS it is the possibility to explore the site in virtual way. Some virtual tours can be showed by hyperlinks too. They, collected from different strategic point of views into the heritage site and geolocalized by a mobile GPS, have been realized expressly for a pre-visit of the
site. The virtual tours have been enhanced adding the descriptive report sheets told above, displayed in PDF format selecting the related hotspot (Fig.4). However there is also the necessity to introduce the heritage ruins directly on-site, because of these are not always accessible, the visitor route is sometime not safe or difficult to explore and the ways are long and dangerous. At this point the panoramic tour will be shared on web for a widespread dissemination of the information and will be located in the Museo de Sitio giving the better solution for a preview knowledge of the site for the visitors.

4. Architectonic analysis and virtual reconstruction of some structures
In relation to the task to have a greater knowledge about some archaeological emergencies, the choice to focus our attention on Palacio Rivero has been determined by two factors. The first, for all practical purposes, it is close to Palacio Tschudi, the only archaeological emergencies currently restored and open to visitors. The aims are to extent the visiting area and create another tourist pole within the site. The second factor is that Palacio Rivero, small and well-preserved, is organized according to a typical tripartite plan that is common to many ciudadelas of Chan Chan and it could represent a model for the
study of the Chimu organization and culture. For this reason we decided to create a three-dimensional model of the building that can be made available to scholars and tourists, also through virtual reality solutions. Moreover the three-dimensional documentation represents a fundamental element for planning the restoration works.

In order to perform the 3D survey we are using, in the course of time, different types of technologies. In the first two years of the research mission we realized a contour lines survey by means of a differential GPS used in cinematic mode [Colosi and Orazi, 2003, 465-474], while in the following years advanced photogrammetric and topographic methods have been experimented in integrated way. To survey the external walls of the building we used the close range photogrammetry by means of triplets of overlapped images, while to detect the very articulated first sector of the ciudadelas we preferred to apply an aerial photogrammetric method based on the use of three cameras shooting simultaneously and hanging from an aerostatic balloon (Menci Fly-Scan system) [Colosi et al., 2009, e27 – e34; Colosi et al., 2011, 244-251].

The second and the third sector of the palace are characterized by large open spaces, by regular rows of warehouses and by the plataforma de entierro, the tomb of the sovereign, which looks like a great mass of earth where it is difficult to recognize the original shape of the monument. Due to the characteristics of these structures, it was decided to operate with the CAM2 Laser Scanner Focus3D. Considering that the view from above provides the best results in the survey of the lunar landscape of Chan Chan, the laser scanner has been mounted on a telescopic rod that can be raised up to 5 meters (Fig.5, on the left). The survey has been carried out with about 160 station points whose range maps have been aligned by means of total station measurements and connected by targets with the topographic network of the first sector. In the Fig.5 (on the right) is represented the 3D survey of the Plataforma de Entierro that shows in detail the large number of cavities inflicted on the original stepped pyramid by the interventions of the Conquistadores and huaqueros and highlights some parts of the walls that still preserve their original shape. In Figure 6 the result of the 3D survey of a warehouses area as point cloud is shown; successively the virtual reconstruction of the warehouses of the second sector coming from

Fig.5 - Survey of the second sector of Palacio Rivero. The laser scanner has been mounted on a telescopic rod (on the left). 3D survey of the Plataforma de Entierro (on the right)
laser data and some historical information.
For the same reason told above, we mean to create virtual reconstructions of the main architectural typologies of Chan Chan area, to show them in the Museo de Sitio, with the purpose to help the tourists to orientate themselves among the ruins, not always easy to read or find.

5. Program for the enhancement of the monumental complex
In Chan Chan the tourist currently has only the possibility of a short visit to the Museo de Sitio and to Palacio Tschudi. The project of the Archaeological Park foresees, instead, that the tourist can spend an entire day in contact with the different aspects of the ancient town. The plan of the Archaeological Park wants to point out, therefore, the definition of a set of “constituent elements” that may become as many poles of attraction to discover the architectural and natural landscape. The Archaeological Park will be organized in order to highlight some territorial elements with specific functions (museum activity, observation points, reforestation areas, archaeological sites, recreational areas for children etc.) that will be connected through predetermined paths accessible by means of electric locomotion. The tour of Chan Chan could start from Huaca Obispo, a natural lookout of the whole complex, then could go to Huaca Olvido, a small sanctuary with an entirely reconstructable volume, proceed to the still intact warehouses of Palacio Laberinto and Palacio Uhle, pass through the Huachaque where the totora was cultivated, with a view of the nearby ocean, until arrive to the network of paths, often elevated with earth embankments on the surrounding fields, and to the Camino Cerimonial. An example of the same itinerary was made by the virtual visit, carried on in the course of 2012 and based on twenty-eight 360° panoramic views and will be showed in the Museo de Sitio.

The enhancement of Chan Chan is also related to the rediscovery and exploitation of traditional activities connected with the archaeological site, such as the cultivation of some species of plants or the development of the historic handicraft. In order to achieve these goals, the MIPE has promoted agreements between Italian and Peruvian organizations and has carried out, in collaboration with the Instituto Italo Latino Americano (IILA) and financed by
the Ministry of Foreign Affairs and by the Lazio Region, a program for the “Support to the socio-economic development of the area of the Archaeological Park of Chan Chan and its territory” which included training stages for experts in the field of cultural heritage and training courses for craftsmen of ceramics [Colosi and Orazi, 2001]. The courses were aimed at the refinement of the professional skills of young artisans working in ceramics, at the construction of a permanent handicraft laboratory and at the creation of a network of “quality pottery”. According to this perspective, the archaeological resource becomes a key element in the socio-economic and cultural growth of the La Libertad region.

Conclusions

The archaeological site of Chan Chan has such dimensions that cannot be studied and managed without the aid of modern analysis and management tools. At the same way, the construction technique of adobe involves considerable problems of documentation and conservation that can be partially solved through the integration of methodologies for the data collection and cataloguing. The remote sensing analysis has allowed identifying unknown archaeological remains and defining, on the basis of these findings, a wide buffer zone that must be protected and safeguarded. The management of the data within the GIS will be very useful for the officials involved in the protection of the territory. Moreover, the GIS is an important tool of analysis and research that has allowed us to reconstruct the planning scheme of the ancient town. The individuation of the different functional areas (residential quarters, popular quarters, agricultural areas, sacred structures, monumental tombs, cemeteries) and the reconstruction of the connecting roads between the religious, political and economic nucleus has shed new light on the social Chimú organization [Colosi and Orazi, 2011, 139-172]. A so articulated ancient urban centre cannot be quickly and partially visited as it is today. Palacio Tschudi represents only the 1% of the whole archaeological site and it cannot explain, by itself, the beauty of the monumental complex and the landscape. It is, therefore, necessary to plan new touristic routes and, with the help of the 3D surveys, to rebuild, in virtual way, the impressive architecture, now partially destroyed. Chan Chan is a fundamental resource for the La Libertad region, and then must be exploited and well introduced to the international community. The museum, from this perspective, must become a central reference to manage and connect each features of the territory where the tourist can be led to the discovery of a fascinating culture and of ancient traditions still living among the local population.

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