

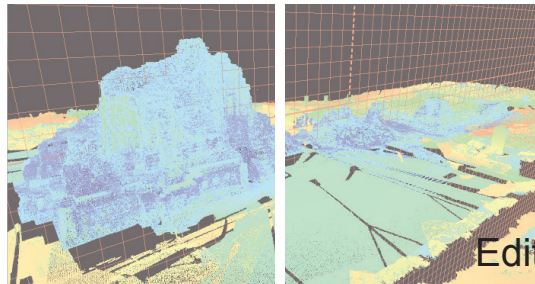
International Conference Built Heritage 2013 Monitoring Conservation Management

POLITECNICO DI MILANO



CENTRO PER LA
CONSERVAZIONE E
VALORIZZAZIONE DEI
BENI CULTURALI

POLITECNICO DI MILANO
150



Online Proceedings of the Conference

BUILT HERITAGE 2013 **Monitoring Conservation** **and Management**

Milan, Italy
18-20 November 2013

Editor in chief M. Boriani
Edited by R. Gabaglio, D. Gulotta



Online Proceedings of Conference
Built Heritage 2013 - Monitoring Conservation and Management
Milan - Italy, 18-20 November 2013
Editor in chief M. Boriani, edited by R. Gabaglio, D. Gulotta

Politecnico di Milano, Centro per la Conservazione e Valorizzazione dei Beni Culturali,
Milano, novembre 2013
ISBN 978-88-908961-0-1

Scientific Committee

Politecnico di Milano

Lucia Toniolo, Chair, *Department of Chemistry, Materials and Chemical Engineering “Giulio Natta”*

Maurizio Boriani, *Department of Architecture and Urban Studies*

Rinaldo Cubeddu, *Department of Physics*

Stefano Della Torre, *Architecture, Built Environment and Construction Engineering*

Carolina Di Biase, *Department of Architecture and Urban Studies*

Gabriele Guidi, *Department of Mechanics*

Cesare Joppolo, *Department of Energy*

Pietro Marani, *Department of Design*

Paolo Paolini, *Department of Electronics, Informatics and Bioengineering*

Luigi Zanzi, *Department of Civil and Environmental Engineering*

Honor Committee

Francesco Bandarin, *Unesco, Paris (France)*

Amedeo Bellini, *Politecnico di Milano, Milan (Italy)*

Luigia Binda, *Politecnico di Milano, Milan (Italy)*

Caterina Bon Valsassina, *Direzione Regionale per i beni culturali e paesaggistici della Lombardia, Milan (Italy)*

Marco Dezzi Bardeschi, *Politecnico di Milano, Milan (Italy)*

May Cassar, *CSH, University College London, London (UK)*

Sharon Cather, *The Courtauld Institute of Art, London (UK)*

Giacomo Chiari, *Getty Conservation Institute, Los Angeles (USA)*

Mauro Cucarzi, *Fondazione Lerici, Rome (Italy)*

Stefano De Caro, *International Centre for the Study of the Preservation and Restoration of Cultural Property - ICCROM, Rome (Italy)*

Mike Forde, *University of Edinburgh, Edinburgh (UK)*

Maurizio Forte, *Duke University, Durham, NC (USA)*

Gary Lock, *Oxford University, Oxford (UK)*

Marco Magnifico, *Fondo Ambiente Italiano, Milan (Italy)*

Claudio Modena, *Università degli Studi di Padova, Padova (Italy)*

Cristina Sabbioni, *CNR ISAC, Bologna, Bologna (Italy)*

Salvatore Siano, *CNR IFAC, Firenze, Florence (Italy)*

Organizing Committee

Politecnico di Milano

Lucia Toniolo, Chair, *Department of Chemistry, Materials and Chemical Engineering*

Nicoletta Di Blas, *Department of Electronics, Informatics and Bioengineering*

Rossana Gabaglio, *Department of Architecture and Urban Studies*

Davide Gulotta, *Department of Chemistry, Materials and Chemical Engineering*

Austin Nevin, *CNR Institute for Photonics and Nanotechnologies*

Michele Russo, *Department of Design*

Maria Licia Zuzzaro, *Department of Architecture and Urban Studies*

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*

K. Basili, R. Codello, G. De Vettor, P. Gasparoli, F. Pianezze, A.T. Ronchi, G. Totaro, F. Trovò *Wear processes in architectural heritage: definition, studies, contrasting measures. The case of UNESCO World Heritage Site "Venice and its Lagoon"*

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, Perú*

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. Gabbrielli, 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*

C. Maierhofer, R. Krankenhagen, P. Myrach, J. Meinhardt, U. Kalisch, C. Hennen, R. Mecke, T. Seidl, M. Schiller *Monitoring of cracks in historic concrete structures using optical, thermal and acoustical methods*

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*

S. Voltolina, C. Aibéo, T. Cavallin, E. Egel, M. Favaro, V. Kamenova, L. Nodari, A. Pavlov, I. Pavlova, S. Simon, P. Scopece, E. Verga Falzacappa, A. Patelli *Assessment of atmospheric plasma torches for cleaning of architectural surfaces*

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 radio-carbon 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 - Multidisciplinary in a multiple case study*

I. Papayianni, M. Stefanidou, V. Pachtas *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. Buyukmihci & 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. Davide 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 pavillion - 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. Janvier-Badosa, C. Stefani, X. Brunetaud, K. Beck, L. De Luca, M. A-Mukhtar *Documentation and analysis of 3D mappings for monument diagnosis*

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*

C. Pasquarella, G. Pasquariello, C. Balocco, E. Saccani, M. Ugolotti, O. Maggi, R. Albertini *An integrated approach to the preventive conservation of cultural heritage: indoor biological environmental monitoring*

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*

C. Di Benedetto, S. Bianchin, A. Langella, M. Favaro, A. Gambirasi, A. Colella, G. Luca, M. Soranzo, M. de' Gennaro, P. Cappelletti *The Neapolitan Yellow Tuff: experimental investigations about effectiveness of antistressing treatment*

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*

N. Proietti, D. Capitani, V. Di Tullio, R. Olmi, S. Priori, C. Riminesi, A. Sansonetti, F. Tasso, E. Rosina *MOdiHMA at Sforza Castle in Milano: Innovative Techniques for Moisture Detection in Historical Masonry*

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*

I

A. Goppion, A. Gioria, G. Cotrufo *Museology meets conservation: Goppion display-cases with multiple microclimate*

A. Bernardi, F. Becherini, A. Vivarelli, C. Ghiretti, E. Mendez Bertolo, L. Pockel  , M.D. Romero-Sanchez, N. Tellado, R. Wansdr  nk *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. Benabdelkader & 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-modelling for 3D historical architecture modelling*

Day 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*

A. Sanna & G. Monni *Recovery, reuse of designs of the Carbonia's dwelling. Proposal for a "Handbook for the Recovery of Modernist Building"*

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 multidisciplinary in the protection of the 20th Century architectonic 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 districtal 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*

P. Giandebiaggi, M. Rossi, C. Tedeschi *The "survey of memory". Cultural heritage in cemeteries: development of a catalogue protocol from the "representation" of multidisciplinary*

disciplinary 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. Nedvěďová & 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*

M. Favaro, M. Chiurato, P. Tomasin, F. Ossola, N. El Habra, I. Svensson, E. Beckers, V.J. Forrat Pérez, M.D. Romero Sánchez, A. Bernardi *Calcium and magnesium alkoxides for conservation treatment of stone and wood in built heritage*

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. Jadiccio 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 NO_x 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 *TiO₂-SiO₂-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 Naple*

Recovery and reuse of the Carbonia's dwellings. Proposal for a "Handbook for the Recovery of Modernist Building"

Antonello Sanna, Giuseppina Monni

University of Cagliari, Department of Civil and Environmental Engineering and Architecture, DICAAR, Cagliari, Italy

The "Handbook for the Recovery" of modernist buildings coincides with a significant stage in the study still underway that concerns that branch of research regarding the preservation and recovery of modern heritage and in particular in the renewal of the residential buildings and the urban fabric. Together with the satellite towns Bacu Abis and Cortoghiana, Carbonia has an architectural and landscape heritage that may be called an "author's product" designed and built with high levels of quality, an emblem of 1930's industrial modernization in Sardinia, currently invested by specific challenges of recovery and reuse. It is not a matter of specific pin-pointed problems regarding single objects, although relevant, but rather a problem involving the complex urban organism, that requires complex and articulated strategies to deal.

The reasons for the foundation of Carbonia must be found in the discovery of the massive coal deposits in Serbariu, and more upstream in the desire to build an autarkic coal district able to answer the nationwide issue of energy sources. The salient phase and then the deep crisis affecting the political strategy soon forced Carbonia to confront with the fragility of the urban and industrial programme, not always able to adapt to the new purposes and new collective practices. Following the mine's closure, Carbonia has gone from an incredibly rapid growth to an extreme crisis that called into question its very existence and undermined the identity of the foundational phase.

For this reason, since 2001, the city administration, with the scientific support of a multidisciplinary team of the University of Cagliari, started up the process of sustainable recovery based on the culture's economy and the search for renewable energy. The program focuses primarily on the recovery of the Great Mine of Serbariu that, in the time frame of ten years, has been turned from a symbol of the industrial modernization into a centre of cultural and technological development. And thanks to the restoration project for this industrial landscape, characterized by its rationalist architecture, Carbonia won the *Landscape Award of the Council of Europe* in 2010-2011. It is then added to the most famous European cases regarding the restoration of a company town, a large development project based on the construction of an integrated industrial landscape.

The construction of the first-phase project of the coal town, which provides for a population of some 12,000 inhabitants, begins in 1937 and concludes at the end of 1938. Shortly afterwards the inauguration it begins the construction of the second-phase project that is expected to welcome 50,000 residents and will end in the immediate post-war period. The outcome is a company town at the mouth of the mine, formed by the serial repetition of few buildings types in a hierarchal urban design of high-quality landscape.

Gustavo Pulitzer Finali, a fine yacht designer born in Trieste who drew plan and buildings of the coal town of Arsia in Istria, and the roman Cesare Valle and Ignazio Guidi, that shortly after will sign the plan of Addis Abeba, designed a

garden city perfectly integrated into the landscape but also in direct contact with the mine. In a second moment the young Eugenio Montuori was added to the team, he drew among others the central single workers' accommodation, known as the Albergo Centrale. Soon after in 1940 Saverio Muratori will be engaged with the construction of the neighbouring satellite town of Cortoghiana, for which he designed the urban asset, public buildings and most of the residential building types.



Fig.1 - Carbonia. View of the company town from the north, 1940

Those young designers, almost all in their early thirties, had then to deal with the need of synthesis between the "modern" requirement of their cultural positions and the limits imposed by autarky, furthermore emphasized by scarcity of the resources and the difficulties in the supply of the materials.

The workers' lodging types of the first-phase project, two-storey four-families homes surrounded by a garden and also designed in the forms of "autarkical rationalism," were a sort of a local version of the typical English cottage, a symbol of preindustrial and rural houses. For some precedents of this compromise, we have to refer to the lesson of Muthesius or to Tessenow's "modernity with no avant-garde." And the result may be called a version of "Mediterranean rationalism" that sought a mediation between the masonry in elevation and the introduction of the reinforced concrete.

The single workers' accommodations deserve a separate discussion. They constitute a substantial change of scale in relation to the types of the garden cities; their urban dimension is enhanced by their disposition in pairs heading down the main pathways connecting the dwellings with the mine. Those are the only residential building types of Carbonia directly attributable to G. Pulitzer. There he used a reinforced concrete floor "type-Rex", and a structure of reinforced concrete trusses with a section extremely thin to cover environments

with a space 10-12m wide. That relatively simple grid structure, which Pulitzer also used in the building called Dopolavoro (OND), is an interesting element of continuity between the civil construction of Carbonia and the buildings of the "Great Mine" of Serbariu. Although it was a distinctively "technical and industrial" detail used in the "Great Mine," it had been applied on residential buildings types, witnessing the interplay between constructive culture of Carbonia and its mine.

In the division of the roles of autarkic policy, the mine depicts the technological development at the highest level. The large reinforced concrete trusses with their slender section in the workshops, and the electrical plant are juxtaposed to the infrastructure of the "steel castle". In the Lampisteria or Lamp room (the hub connecting the town with the galleries in which the miners picked up their headlamps before descending) the barrel vault, realized with a sequence of reinforced concrete arches of great span hidden by an evenly plastered surface, abandoned its original meaning of massive formal element. A skylight overhead, enclosed in glass blocks, exposes the structural game and helps to emphasize the metaphysical character of this space.

Following the intervention of recovery, mostly financed with European funds, the pavilions of the mine have become the nodes in a network of activities oriented to the culture, research and industrial development of sustainability, innovation and energy efficiency. The Lampisteria has been transformed into the Italian Center of Coal Culture (Centro Italiano della Cultura del Carbone), a combination scientific and anthropological eco-museum. The original path to fruition of the miners has been reconstituted by the recovery of galleries and wells equipped with elevators. The library and historical archives of the mine and the city are located in the adjacent pavilions, the Officine hosts another scientific museum, the Museo dei Paleoambienti Sulcitani. The Tornerie houses a research facility for the University higher education, dedicated to the experimentation of solutions for energy efficiency and alternative energy sources. Another contiguous industrial building, serving the mine, hosts the "Sotacarbo," a centre for sustainable energy research and experimentation on the use of coal.

The recovery of the mine is part of a more ambitious goal, represented by the requalification of the entire urban and territorial system of the company town. The intrinsic "permeability" of the garden city has made the buildings vulnerable to the corrosion and eased the severe decay of houses, seriously compromising the understanding of the original idea.

The point of departure coincided with the new urban plan that is conceived as a heterogeneous and diversified tool with a series of studies that create a complex strategy and design process. The plan is based on a few key elements. The first expression of the new urban plan is the "Quality Charter", written to function as a summary of previous papers and matrix of coherence for the city's urban and design strategies.

The second is an Architectural Quality Workshop", the coordination centre for the realisation and design activities for the restoration of public heritage which scientifically monitors the jobsites. It checks and controls the private sector initiatives that bring about and actually conduct the interventions in the company residential spaces.

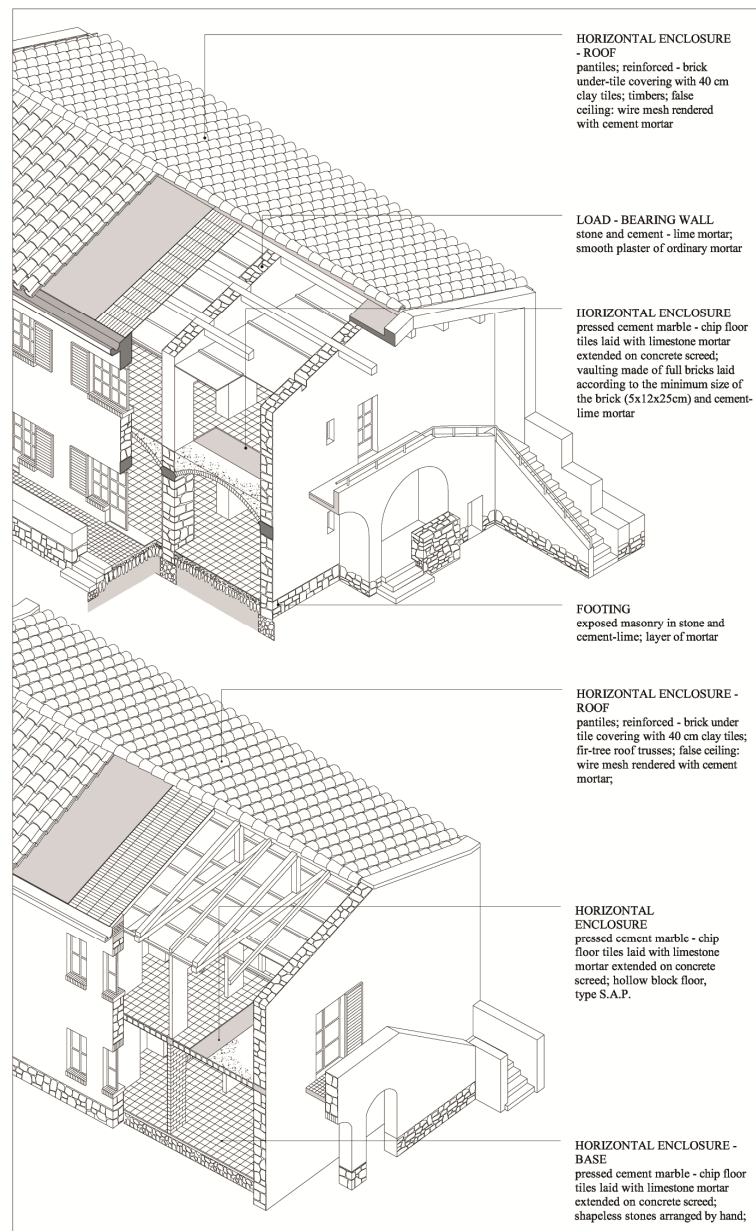


Fig.2 The comparison between two cut-aways: the “Lacchi” type, realized in the first phase, and the “Gra N” type, that belong to the first phase of construction

It is, therefore, perfecting and implementing a complex strategy aimed at flexible restoration policy that deals with problems directly connected to the coexistence between various cultures, their housing tendencies and the original architecture of Carbonia's buildings. The third key element is the “Handbook for the recovery” of modernist buildings, i.e. an operational tool of guidance and support interventions on heritage. In the tension that is generated in the time between continuity and change, the Handbook is designed to ensure the quality of the conservation project: it investigates the traces of the 'how to build' of the autarkic rationalism, it studies the anatomy of the buildings of the foundation with an effort of critical reconstruction of design and construction cultures, it begins to outline the guidelines for the difficult path between the preservation of

witness buildings and the regeneration of its changed urban fabric. It does not provide a catalogue of standardized solutions, but merely defines a knowledge base to guide the designers towards the recognition of the buildings' invariant aspects and towards the understanding of the original architectural expression. The "Handbook" is emerging as a "Code of Practice": through technologically advanced analysis it identifies features and fundamental performances of building components and identify design methods consistent with the objective of conservation. The "Material Technologies Working Group" has carried out sample surveys on the built heritage of Carbonia with functional objectives for the preparation of the Handbook: assessment of the state of artifacts' conservation, identification of the weathering forms and damage categories; preparation of an atlas of the degradation forms; instrumental checks on materials and technological object of interest. With particular reference to the production technology of the materials most relevant, especially binders, reinforced concrete, bricks. The information gathered from these surveys are the key elements and guidance for proper planning of interventions on the built heritage.

It explores the history of the construction methods of autarkic rationalism also making use of all the documents found in the archives: such as design drawings, historical photographs and especially booklets yard. It reconstructs the anatomy of the early buildings, investigating on the connection between design - construction – modification also through careful study of the detail solutions. At the same time, the search path will analyze and discuss the practices of intervention in cases of recovery already made and verified in the field. Emblematic in this regard is the intervention of conservation and recovery of the industrial building whose specificity has required diversified modes of intervention. The thin sections of the trusses and the thickness too contained of the iron covers, now out of norm, did not give sufficient guarantees against corrosion and in many cases the concrete is absolutely disaggregated and iron completely corroded. Sometimes, recourse was made to complete replacement and reconstruction "as it was where it was", especially in a case in which the great structural skeleton of the roof (which the process of degradation had revealed), is left in sight and used as a container open air, i.e. "an architecture inside the architecture".

In the building that hosts the historical archives the iron structure has been recovered with the carbon fibers and the original trusses have been restored in situ. And more in the Officine, transformed into the Museo dei Paleoambienti Sulcitani, however, the load-bearing masonry has been emptied and the roof, irreversibly collapsed, was reconstructed with steel structures.

An other meaningful intervention, documented and discussed, is the recovery of the Dopolavoro (OND) designed by Pulitzer in 1937. Also, this operation required different approaches. The high-ceilinged hall, used originally as a local leisure hall, was returned to its initial spatial configuration even if the function has of necessity become the new civic assembly hall, fully compatible with the architectural and spatial features of the Dopolavoro.

The existing fixtures and plaster facade of the porch were the subject to "philological" restoration. The recovery of the gutter has posed important

problems in terms of method, because of the discrepancies between the original designs and construction, and its technical defects.

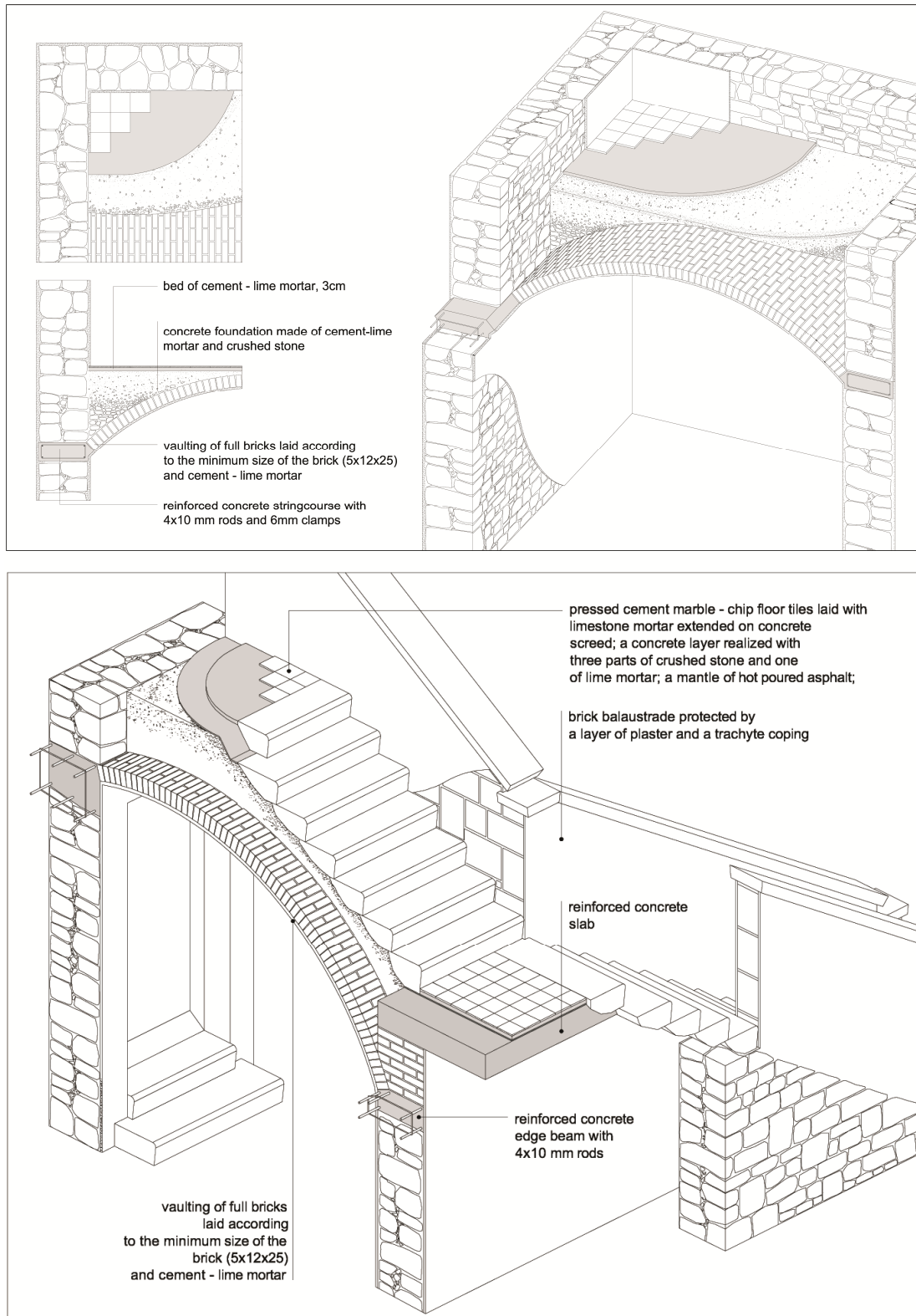


Fig.3 - A datasheets from the "Handbook for the recovery": the design detail of the arched floor and scale used in the "Lenti standard" type

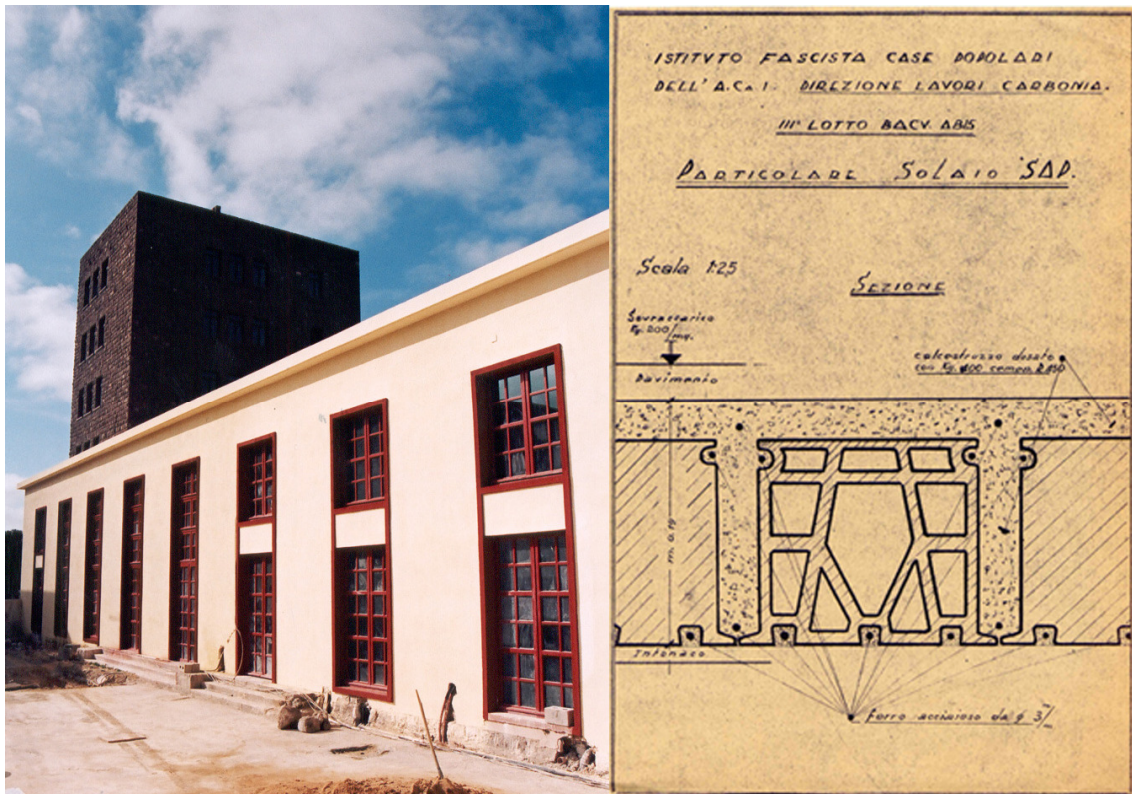


Fig.4 - The restoration of the Dopolavoro; "Sap" type attic detail, (Carbonia, AREA record office)

From the drawings and site documents it emerged that Pulitzer had planned to protrude the gutter and to use a reinforced-concrete floor between trusses. During construction, the projection was reduced to 30cm and it was preferred to use thin reinforced bricks known as "Perret," which is more fragile and much more breakable. The latter has collapsed because of the extreme slenderness and the iron oxidation so it was replaced in the 1980s with a reinforced concrete floor of greater depth and mass, which, however, has compromised the function of the gutter to the "reduced" extent " with which it was originally performed. Moreover, the investigation of project documents has made it clear that the importance and the strong projection of the gutter was linked to the design role that Pulitzer gives it in his buildings. This aspect emerges with even greater clarity in the single miners' accommodation, where the gutter reaches the eaves, jutting out 60cm, performing admirably in the protective function that is proper, but at the same time mitigating the "domestic" character of the gabled roof. While retaining the traditional structure, he was able to give the illusion of a "modern" pure volume covered with a terrace from an angular perspective. Thus the restoration has led to the reconstruction of the gutter in compliance with the intent of the original design but with a height compatible with the modifications already undertaken and considered irreversible.

Also one of the single workers' accommodations, however, was the subject of an action for recovery. The relatively good state of preservation of this historic architecture has guided the intervention towards a "philological" conservation and with the support of the Materials Technologies Working Group it was possible to recover the original plaster and the flooring. However, it was

necessary to change the initial function with a compatible use. And so this building currently is a Youth Integrated Education Centre.

The same philosophy is also applied to intervene in the public space. The Handbook develops an accurate philological reconstruction of the phases of the project and realization of the central square Piazza Roma, where is condensed the architecture of public institutions that gave rise to the company town: the headquarters of the Party (Torre Littoria), its propaganda buildings (Cine-Teatro, Dopolavoro), the Church and the City Hall. Every public building has its "thematic square", with paved floor and water points, while the rest of the square was once an undifferentiated area covered with dirt, gravel, asphalt. The urban regeneration project has reconstructed the original concept of the central square, transforming it into a pedestrian space with a homogeneous and "abstract" stone surface recovering also the meaning of "metaphysics" of the great urban space.

References

- A. Sanna, *Project Carbonia: Landscape Machine from 20th Century Company Town to 21th Century Landscape*, in *The Survival of Modern*, 12th international Docomomo Conference, Bookwell Oy, Porvoo-Helsinki 2013
- A. Sanna, *Restaurare un paesaggio industriale: il caso Carbonia*, in *Territorio*, 62, 2012
- A. Sanna, G. Peghin (edited by), *Modern and Urban Heritage, Experiences and reflections for the twentieth-Century City*, Umberto Allemandi & C., Torino, 2012
- G. Peghin, A. Sanna, Carbonia. *Città del Novecento*, Skira, Milano, 2009
- G. Peghin, *Quartieri e città del Novecento. Da Pessac a Carbonia. La tutela del patrimonio urbano moderno*, Franco Angeli, Milano, 2010
- A. Sanna, (edited by), *Tipi e caratteri dell'abitazione razionale: il laboratorio Carbonia*, Cucc, Cagliari 2004
- A. Sanna, *Il recupero del moderno*, in «Parametro», 238, 2002
- A. Sanna, *La ricerca e il progetto*, in «Docomomo» Italia Giornale, 26, 2010.

Milano, novembre 2013

ISBN 978-88-908961-0-1



9 788890 896101