

Metric survey and possible representations of Historic Architectural Heritage: the case of the Santa Giustina Abbey

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ARCHITECTURE HERITAGE and DESIGN

Carmine Gambardella

XVI INTERNATIONAL FORUM

Le Vie dei
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WORLD HERITAGE and KNOWLEDGE

Representation | Restoration | Redesign | Resilience

ARCHITECTURE HERITAGE and DESIGN | 2
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Le Vie dei Mercanti
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Preface

In the present era, technologies are becoming increasingly important in helping and supporting man in research, knowledge and production activities, almost as if they were smart prostheses. With the theme of the XVI Forum “World Heritage and Knowledge”, I propose to the International Scientific Community to debate and establish a comparison of knowledge carriers to communicate methodologies of good practices adopted and experiences in the use in the protection, conservation and safeguarding of cultural heritage and landscape as well as in the design of the “new,” that, adopting in the building processes and building construction Innovative Building Modelling, can realise a non-contemporaneity of what has the same date (Giulio Carlo Argan) respectful of the values of the pre-existing, legitimate because it participated ex ante and monitored becoming all its ethical, aesthetic and performance connotations.

With the Internet of things, for example, sensors that are used to produce data autonomously that widen the processes of knowledge on all levels, from the territory with its infrastructures, to the environment, to the artefacts entering into the body itself of their physicality, or, in the case of the new, building the project as a prediction throughout physical consistency.

Nevertheless, the use of new technologies allows for economies of scale, both temporal and economical, not only for the surveying and representation of the built and the territory in the analysis phase but above all for the management of the resulting data that makes the design activity of the restoration of the historical heritage and landscape or of the newly constructed in a single process no longer divided into steps but also unitary in concrete constructions and the realisation of the works, in the intermediate checks, in the testing, in the monitoring and in the programmed maintenance.

In conclusion, it is indispensable for the scientific community to highlight how technologies, without a responsible attitude that commit man’s choices and knowledge in dealing with and planning appropriate responses to the issues and needs of the collective, can create a deception that unfortunately materialises with the subtle persuasion of uncontrolled astonishment that overwhelms the imagination.

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XVI INTERNATIONAL FORUM

WORLD HERITAGE and KNOWLEDGE

Representation | Restoration | Redesign | Resilience

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Metric survey and possible representations of Historic Architectural Heritage: the case of the Santa Giustina Abbey

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Abstract

The semi-automatic metric survey techniques developed in the past years allow the recording of 3D models with an ever-increasing level of details and accuracies.

The 3D database, usually georeferenced in a cartographic system, opens the floor to different kind of representations (e.g. 2D drawings, 3D models, digital animations, AR/MR applications etc.) conceived to satisfy different requirements at different graphic scales and aimed to increasing the knowledge of Cultural Heritage.

The paper introduces some different representations that can be extracted from a 3D database: the “as built” representations, which put in evidence all the irregularities of a real building, as it today appears because of anthropic interventions and endogenous/exogenous events happened during its life.

Starting from this 3D database the main task of the representations is interpreting and synthesizing the collected information aiming to recognize the architectural values of the building, the geometric matrices of the shape, the modularity of the composition, and the relationships between architecture and decoration.

The Romanesque abbey of Santa Giustina in Sezzadio (Italy), a well preserved building, which considerable dimensions, constructive accuracy, and rich decorations testifying its territorial importance, is a significant case study for these purposes. It is a less documented architecture where metric survey and representations has been produced as a first step to support future researches.

Keywords: metric survey, architectural drawing, 3D modeling, graphical analysis, Santa Giustina Abbey

1. Introduction

The documentation of Cultural Heritage assets is one of the most intriguing and urgent needs to preserve cultural values of local and global communities. The starting points of every documentation effort are the historical evolution of the analyzed asset and the geometric knowledge of the full and empty spaces, which define the object to be documented.

The present work concentrates its attention on geometric knowledge acquisition that requires a strong metric survey and a careful set of representations able to put in evidence specific portions of the object and their spatial relationships. Both metric survey and representation cannot be developed properly without a basic historic knowledge able to inform the surveyors about the aims of the survey itself.

3D models generated by metric surveys and *ad hoc* representations of it will be the geometric framework where all the historical data could be connected by forming a database useful to transfer the basic knowledge for further analysis, restoration and conservation planning, and valorization actions.

The experience developed on the Santa Giustina Abbey represents a full example of a balanced cooperation between experts in metric survey and experts in representation to realize and communicate the achieved results.

2. Metric survey

In the last decades, many technological improvements allow the growing up of a new way to develop a metric survey from the primary data acquisition up to the management of them to obtain a 3D model, which represents the normal outcome of a metric survey intervention. 3D models generated by means of correct metric survey approach are the base for the development of different kind of representations that range from traditional 2D drawings up to BIM structures, AR/VR solutions, 3D print, etc. [1].

Despite the fact that up to twenty years ago the selection of the points necessary to start the modelling phases was performed directly by the surveyors, today the intelligence of the survey is applied on a point cloud acquired automatically by using laser scanning instruments or, more recently, by automatic digital photogrammetric methods.

The evolution of technologies and the changes in the modeling do not allow to change the correct design, execution and check of the metric survey procedure.

2.1 Design of a metric survey

The correct approach to design a metric survey can be split into four main preliminary steps. The first thing to be done is the comprehension of the goals of the metric survey by fixing the required accuracy, the deliverables to be produced and the goals that the 3D model has to satisfy. The accuracy (the maximum acceptable metric differences between the final 3D model and the real surveyed object) can assume different values for specific detail or portion of the entire object in order to minimize the costs of the survey and to give, to the final users, the needed information. The deliverables required at the end of the metric survey are of interest because they help to define the level of detail of the survey and, finally, the amount of the necessary primary data [2].

A second step of the planning of a metric survey is the recovering of already existing metric data: in case some existing data are accessible, they have to be tested in terms of accuracy and level of detail limits defined in the first step. Usually historical metric data are not completely documented and therefore not completely usable but, in any case, they could form a good base to plan the actions and to show the modification that occurred on the object over the times.

By considering the requirements and the already existing and acceptable data, it is possible to define the amount of points, which have to be acquired, and their location. That information are of fundamental importance during the selection of the usable metric survey techniques.

The fourth and last step is the selection of the techniques to be used in all the different phases of the metric survey: control network establishment, and detail survey. The use of some of the possible metric survey techniques requires, sometimes, also the establishment of a second order control network: in these cases, also this step must be carefully planned.

2.2 Detail metric survey techniques and strategies

The technology development occurred in the last years caused the almost disappearing of traditional metric survey techniques based on manual distance measurements and the traditional topographic methods using total stations, and also the use of photogrammetry based on stereoscopic plotting. All these three methods ask for the selection of the points to be measured by a skilled operator: the amount of recorded data are reduced to a minimum size and the modelling is done, step-by-step, by the surveyor itself during the point survey.

The introduction on the market of laser scanner devices, push the normal approach of the detail survey towards an automatic (and therefore not intelligent) acquisition of a big amount of points irregularly distributed (the point clouds). The main reason who justify this result is the possibility to generate a big amount of geometric analysis when they are necessary (not during the acquisition period), and to reduce the time needed to acquire the primary data.

Actually, this advantage was true for photogrammetry also since its beginning: the images and some metric information (such as for example a network of Ground Control Points or some distances) constitute the implicit 3D model to be investigated when necessary also years after the acquisition of those primary data. In the same way the point clouds acquired by Laser Scanning Systems form a stable set of metric information that can be used for geometric modelling when necessary and stored for successive uses. The automatic procedure used to generate those point clouds guarantees the objectivity of the primary data (as the images used in photogrammetric surveys) for a subjective interpretation developable in a second step.

The research developed in the last years, shows that a strong integration between Laser Scanning Systems and Photogrammetry can give the best solution: the images acquired by the most recent Laser Scanning instruments allow coloring the point clouds and increase the quality of the interpretation required during the modeling phase.

Point clouds are not 3D models because the points are not topologically connected: points are independent geometric entities and the metric survey cannot be considered totally developed until a real 3D model with defined topological relationships (e.g. line, surface and volume definitions) is built.

The simple use of mesh solutions (e.g. Delaunay triangulation) could be a possible answer for very irregular surfaces where sharp edges are not present, but especially in architectural objects, this approach do not give appreciable results. Geometric break-lines have to be detected to drive the mesh algorithms towards a correct description of the shape of the object. Today no automatic tools can give those results and a huge work of geometric segmentation has to be performed manually by using specific software platforms.

To realization of traditional 2D drawings (e.g. planes, sections, and elevations) is done by cutting the point clouds with the selected section plane, and the point nearest to this plane inside a specific tolerance, are projected onto it and then topologically connected to define the intersection line: this draft line constitute the starting point for the 2D representation.

Recent developments in automatic digital photogrammetry allow generating dense point clouds similar to the ones acquired by using Laser Scanning devices allowing to skip the heavy manual plotting by using stereoscopic vision and to produce an intermediate primary dataset of points starting from the acquired images.

In case of terrestrial applications, the use of drones to acquire stereoscopic images allow today to solve the problem of surveying vertical surfaces facing narrow streets, roofs of buildings, sub-horizontal assets like archaeological excavation sites, etc. The acquired images are used by means of standard photogrammetric tools to complete the point cloud generation.

The density of the point clouds could be different in some part of the surveyed volume due to different requirement for correct representations: the surveyor has to be aware of these requirements in order to be able to realize a 3D model useful for the specific representations defined with the final user.

2.3 Metric survey of the Santa Giustina Abbey

The aim of the metric survey of the Santa Giustina Abbey is to support historical studies and to constitute the metric base for a documentation of the complex. A survey scale of 1:100 was adopted and traditional 2D drawings (e.g. plans, sections and elevations) were chosen as a first way to represent the achieved results.

The Abbey of Santa Giustina has not be documented in acceptable ways during the past. Only one survey made in 2001 during the structural restoration could be partially recovered but the level of detail is not considered sufficient for the aims of the new investigation: in addition, there is not access to the primary data therefore is not possible to certify the metric quality of the recovered drawing. It was decided to use those drawings to describe the interior roof structures and those parts that are not of main interest for the investigations.

The level of detail required to form a metric base for geometric analysis and wall analysis that the researchers would performed, suggest adopting the Terrestrial Laser Scanning technology for interior and exterior walls, and the aerial photogrammetry for the exterior surfaces of the roofs by using a UAV. These aircraft allow the acquisition of the needed images at the sufficient distance to reach the accuracy required by the adopted scale (e.g. tolerance of ± 2 cm).



Fig. 1 – The control network (left) and the Laser Scanner station points (right)

A control network has been established (see Fig. 1) and the survey has been performed by using the scheme of a free network: planimetric measurements have been done by using a total station and levelling by using the differential levelling technique.



Fig. 2 – The FARO FOCUS3D X330 used for the point cloud acquisition and a marker (left) and Marker used for GCPs materialization and the MAVIC PRO UAV system used to acquire aerial images (right)

A second order control network has been realized to allow the registration of the point clouds and to estimate the exterior orientation parameters of the stereoscopic images. The Ground Control Points (GCPs) for the registration of the point clouds have been materialized by traditional signals (see Fig. 2): a total amount of 169 points have been surveyed, by using a total station, in order to allow the registration of the indoor and outdoor point clouds. Almost half of them are used to check the obtained accuracy to certify the metric quality of the final model.

All the scans obtained by using Terrestrial Laser Scanners and automatic matching of acquired images have been oriented in the coordinate system defined by the control network. The mean discrepancies on GCPs used to orient the terrestrial point clouds are less than 1.5 cm and the observed discrepancies of the GCPs used to orient the images acquired by the UAV system (see Fig. 3) are less than 1 cm. The discrepancies on the Check Points not used during the orientation steps are less than 2 cm.

Both these results allow certifying that the final point cloud used to extract 3D metric information have the necessary metric quality defined during the design of the metric survey.

Once the point clouds have been registered, the basic metric information have been extracted to generate the required representations.

The strategy in these cases is to cut the point clouds by considering all the points present inside a volume having a thickness of about two times the required accuracy. All the points contained in this volume are then projected on the needed projection plan and topologically connected to for the draft line that define the required section (see Fig. 4) or elevation.

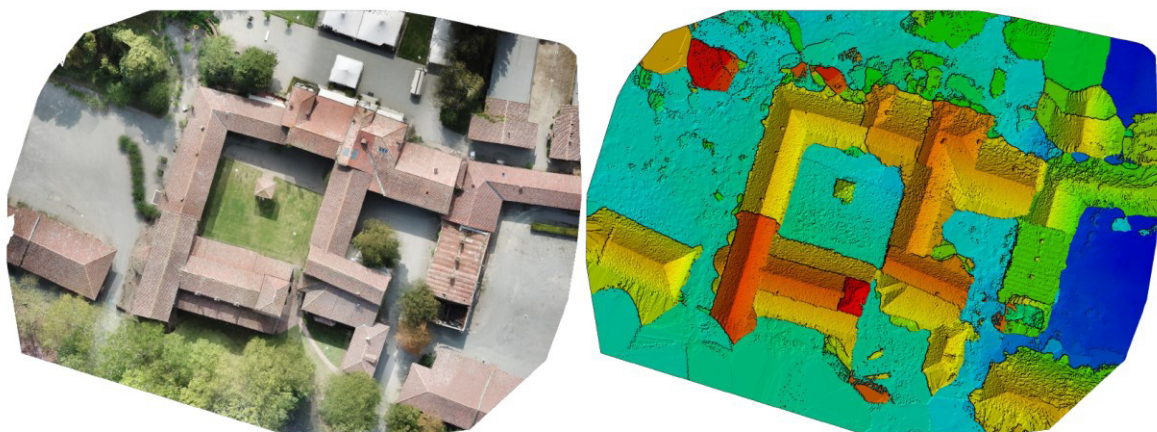


Fig. 3 – One of the aerial images used (left) and the obtained point cloud for roof metric survey (right)

3. Issues of interpretation and representation of the data

The interpretation of the acquired metric data implies a constant and rigorous attention to the formal, structural, and stylistic peculiarities of the building, to the historical period in which it was realized, also in reference to coeval buildings and to the context in which it rises, to the constructive materials used, and to transformations and events happened over time. Documentary materials, archival, bibliographic and iconographic sources contribute in a fundamental way to this knowledge.

Therefore, the architectural survey arises as an open system of knowledge whose documentation is aimed at safeguarding the cultural heritage [5].

The aims of the survey, to be established in the design phase of knowledge operations, guide at all times the representation methods and the contents that they must highlight.

The representation is established as a tool for the synthesis of the acquired knowledge, making a critical selection directed by the pre-established aims.



Fig. 4 – Elevation (left) and section vector-based extraction (right – Top: point cloud – Middle: section line – Bottom: complete section vector-dataset)

The digital revolution has led to an extensive availability of tools: for architectural representation - through drawing, modeling, animation, up to prototyping -; for communication - through virtual visits, interactive explorations, AR, VR, MR -; and for sharing - through websites and open-source platforms-.

3.1 The educational value of the work on Santa Giustina Abbey

The Abbey complex of Santa Giustina in Sezzadio, founded in 1030 by Marquis Otberto and soon the seat of the Benedictine order, has as a fulcrum the church subject of the present study [6], which closes the perimeter of the northern cloister.

The building, described by Porter in 1917 [7] as a minor edifice of the Northern Italy, has considerable dimensions (max length of about 39 m, max width of about 27 m, max height of about 22 m) which testify its relevance in the territory.

It is a Romanesque church, masonry bricks built, having a *crux commissa* plan with three naves delimited by three apses beyond the transept. The crypt occupies the space below the presbytery which is consequently raised. The salient façade is broken in the central part by a watching tower built somewhat earlier than the construction of the Gothic rib vaults on the three naves in the fifteen century [7].

The recognition of the importance of the Abbey led to the hypothesis that there could exist design criteria of a modular nature at the base of the planimetric tracing and, in general, of the spatial concept

of the project. These practices, identified in Cistercian buildings of the twelfth and thirteenth centuries [8], together with the knowledge of geometry in Gothic architectural works, documented in the book by Villard de Honnecourt [9], but also found in previous solutions [10], would have in the Abbey in Sezzadio a really early application.

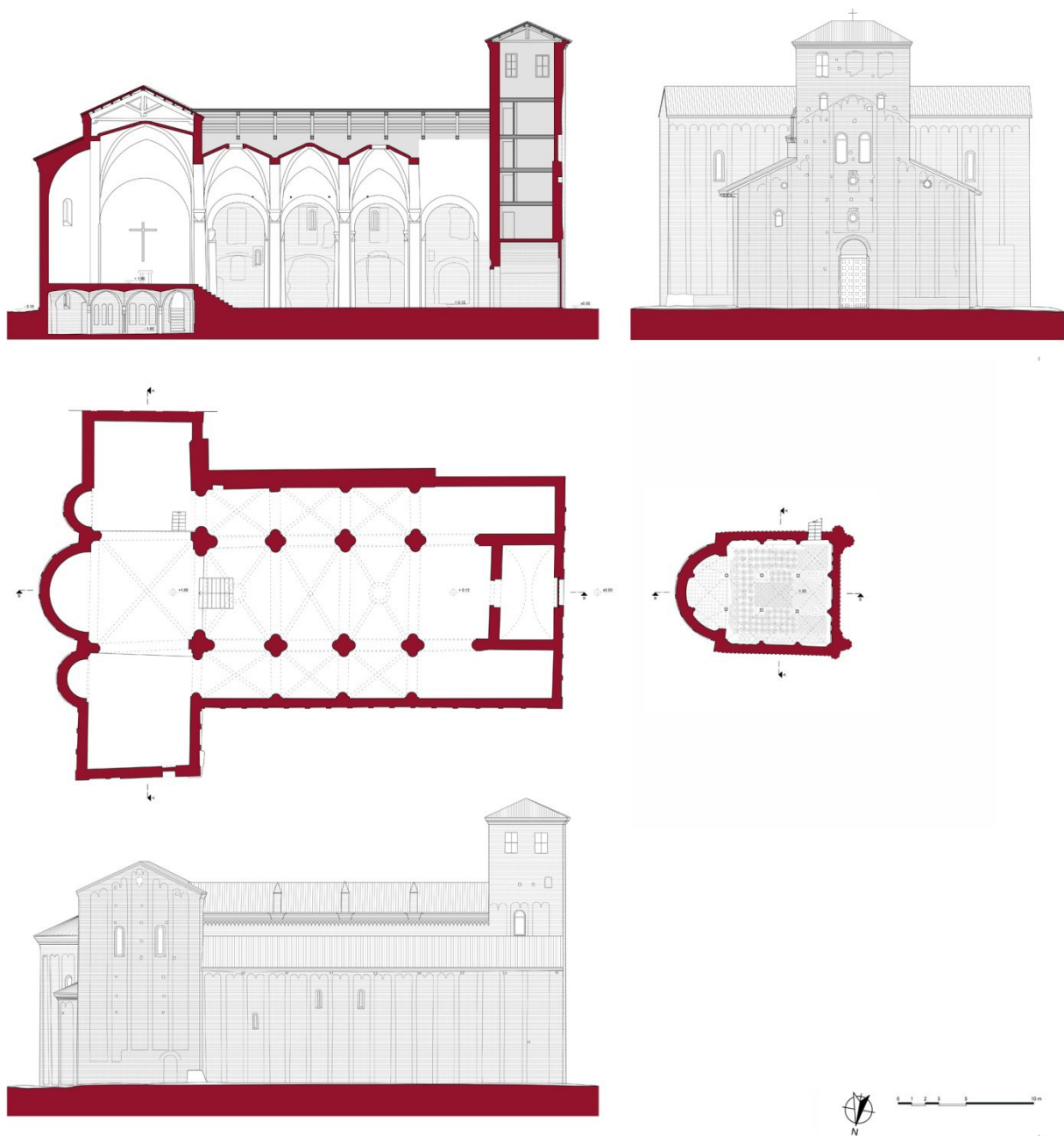


Fig. 5: Plans, elevations, section of Santa Giustina Abbey. Original scale 1:100. Drawing by Alessandro Piovano.

Moreover, the absence of updated representations metrically based on acquisitions realized with the most recent technologies and represented through digital tools, led to the choice to draw up those synthesis drawings essential for an exhaustive description of the object, which also constitute the basis for graphic hypotheses on modularity.

The selection of the cut planes and the reference planes of the point cloud to generate the most significant sections is an operation that is conceptually very complex and didactically particularly educational.

In fact, this selection forces the student to move the section plane parallel to itself in the different levels of the building, in order to intersect the most significant elements, such as keystones, as was done in the case of the present work, for the longitudinal section of the crypt and the central nave.

Similarly, the horizontal section that gives rise to the main plan had to be set at an unconventional height in order to pass on the presbytery floor and intersect the largest possible number of openings at the entrance level.

In addition, the selection of the reference plane in relation to the section plane, which allows visualizing the elevation beyond the section plane, completing the orthographic projection, involves some problems: indeed, when between the two planes many elements are interposed, the reading of the elements on the posterior plane can be difficult.

The passage from the raster image obtained from the point cloud to the vector drawing generates further issues. The selection of the points through which the break-line must pass has to take into account those punctual elements (cracks, thickening of plasters, tie beams) for which the section plane could accidentally pass that could compromise the understanding of the conformation of the artefact (see Fig. 5).

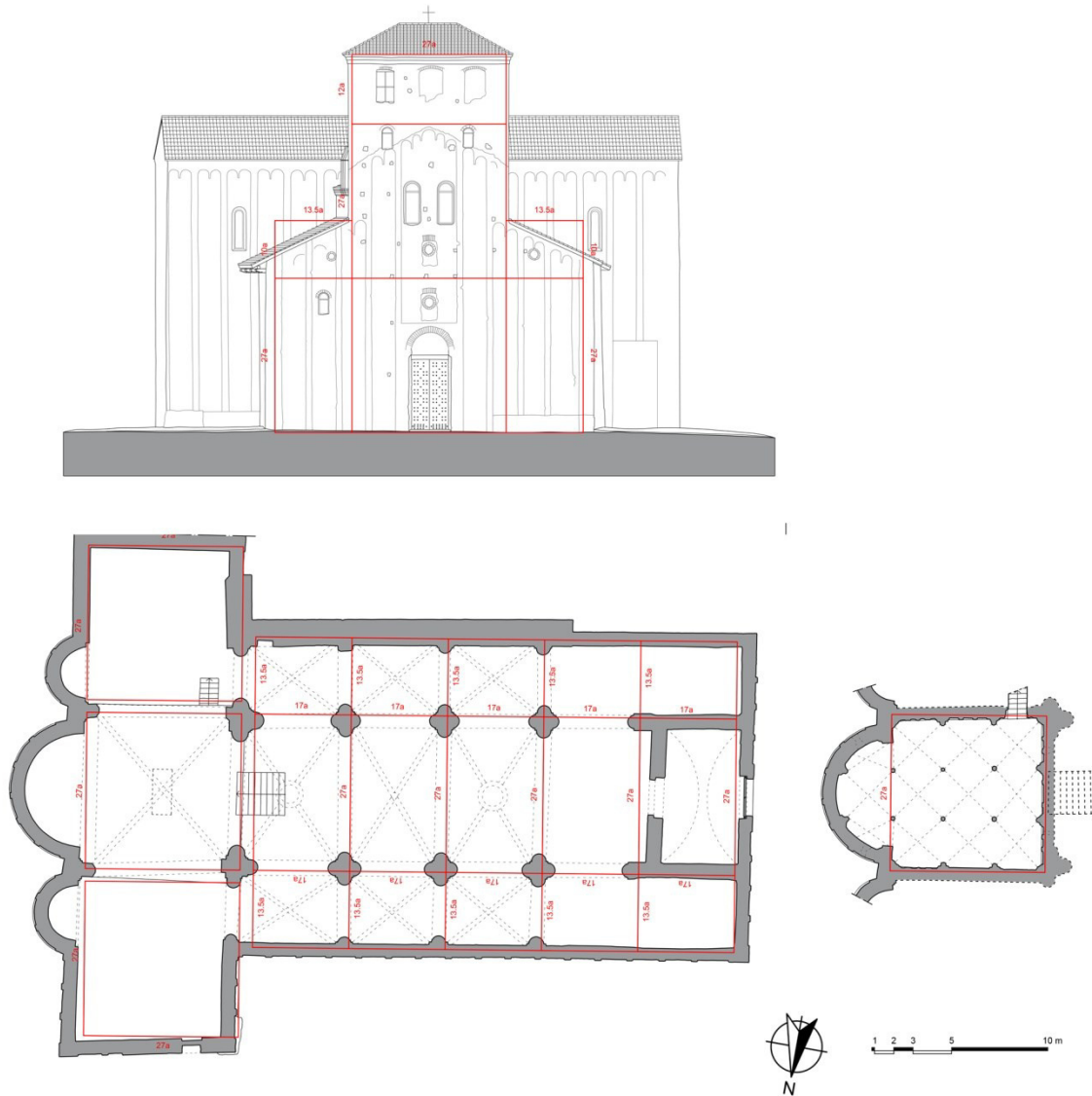


Fig. 6: Graphical analysis of Santa Giustina Abbey. Original scale 1:100. Drawing by Alessandro Piovano.

Vice versa, the points intended as projection of geometrically significant elements: edges, intersections between surfaces, imposts and keystones, must necessarily be taken into account.

In addition, the scale of representation designed for the drawing and the printing suggests the minimum distance for the selection of points, to avoid increasing of time during the work.

The potentiality of printing devices for digital drawings has progressively led to the creation of more detailed drawings than analogical ones, both in the design drawing and in the survey drawing. The relationship between scale of reduction and contents, established by centuries of pen representations on paper and by a series of indications by the standardization bodies (UNI, ISO, EU, CEN4) [11], today sees a search for the detail superior to the past.

At present, distances between parallel lines even below the millimeter are appreciable, and in the 1:100 scale established for the restitution of the Abbey, they are equivalent to 10 or less centimeters measured.

Then, the problem is of a cultural nature, and respecting the criterion of the minimum distance between two lines is not sufficient: for instance, the identification of the main partitions of an architectural order can lead us to decide to draw a line rather than another, in order to communicate a univocal message to the reader of the drawing.

In the examined case study, it was decided to add the geometric information with the architectural ones, such as the virtual projections on the plans' section planes of the vaulted and roof systems.

Furthermore, it has been established to represent elements of recognizable particular value, such as the mosaic flooring of the crypt and to highlight, using a symbolic hatch, the tiles and the visible brick textures in the internal and external façades. The decorations characterized by chromatic variations that do not involve geometric discontinuities have not been taken into consideration: such as the alternating bands, painted in black and white on the pillars and the apparatus of the frescoes, already effectively documented in the point cloud.

Finally, on the synthesis drawings realized with such attentions it has been possible to propose modular readings that refer to the well-established methodology of the graphical analysis [12] [13].

Graphical analysis, in the field of the project's reconstruction, could be recognized as a privileged instrument of architectural criticism because it provides new contributions of knowledge in respect to the only original drawings, the old pictures, the project reports and the critical essays. Graphical analysis, with a translation of practices and meanings, can be fruitfully applied also to the survey drawings. Indeed, in the present case study, it contributes to highlight the figurative reasons of architectures' visible conformation, affirming its heuristic value.

In the abbey, the recurrence of proportional ratios of areal type (square, semi-square) and linear type (M, 1/2 M), that is more convincing in the analysis of the plans and main elevation, seems to rule the whole composition. These relationships also highlight a plausible correspondence with the unit of measurement probably used, the Roman foot (see Fig. 6).

3.2 Beyond the didactic experience: from a point cloud to several possible representations

As mentioned, the availability of the database generated by terrestrial and aerial scans can be the basis for generating multiple types of digital models and drawings, obviously paying attention to the reduction scales provided in the survey project.

Digital geometric models represent a relatively new product, compared to traditional analog representations by orthographic projections. Agreeing with Bertocci and Bini, this model is the product of a synthesis operation performed by the operator who, pursuing a specific communication objective, selects the information of what "is nothing other than a geometric figure representing an architecture" [14].

A particular category of modeling tools that can be used in the survey representation is that of parametric modeling, distinguished in geometric and BIM tools.

The first, by means of form-making strategies seems to be a suitable solution for the studies conducted on existing historical architectures [15] [16]. Anyway, the procedure, that is not comparable to a graphic reproduction gesture but to a real research activity, required the construction of a precise methodology that frames explicit correlations between shapes of an artefact, their geometric properties and the conditions bringing to its formation [17].

The second applied to the historical architecture (HBIM) allow, among other prerogatives, to build families of architectural elements to draw from during the modeling phases and, above all, to manage a series of information associated with the model, aimed at stratigraphic analysis, restoration, static consolidation, energy qualification, management, allowing to record changes that occur over time [18]. Starting from digital models different products can be created, such as animations and scaled physical models made through 3D printers. These products can be a link between representation and communication, triggering processes of perceptive fruition and facilitating the three-dimensional understanding of the artifact by an inexperienced public.

Further steps in this direction, aimed at valorization through the promotion of cultural tourism, can be accomplished by creating virtual visits, interactive explorations, experiences of virtual reality, augmented reality, mixed reality, available *in situ* or shared through websites and open-source platforms.

4. Conclusion

The presented experience is a fluid process within which different knowledges are composed in a multi-disciplinary perspective aimed at the analysis, interpretation and enhancement of Cultural Heritage. The realized database and the first graphic elaborations resulting from its interpretation offer an important contribution to further research involving the disciplines that operate in the field of the

safeguard and enhancement of historical architectures of recognized value, not yet adequately documented.

Credits

Paragraphs 1, 2, 2.1, 2.2, 2.3 are written by Fulvio Rinaudo and Alessandro Piovano, paragraphs 3, 3.1, 3.2, 4 are written by Roberta Spallone, figures 1, 3, 4, 5, 6 are processed by Alessandro Piovano.

Bibliographical References

- [1] STYLIANIDIS Efstratos, REMONDINO Fabio (ed.). *3D recording, documentation and management of Cultural Heritage*. Caithness: Whittles Publishing, 2016. 388 p. ISBN 9781849951685
- [2] BEDFORD Jon, BRYAN Paul, ANDREWS David. *Metric Survey specifications for Cultural Heritage*. Swindon: Historic England Publishing, 2015. 240 p. ISBN 9781848022966
- [3] BASTONERO Paola, et al. Fusion of 3D models derived from TLS and image-based techniques for CH enhanced documentation. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, 2014, 2.5: 73.
- [4] CHIABRANDO Filiberto, et al. 3D modelling of trompe l'oeil decorated vaults using dense matching techniques. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, 2014, 2.5: 97.
- [5] Verso la "Carta del Rilievo Architettonico". In CUNDARI, Cesare, CARNEVALI, Laura (Eds.). *Il Rilievo dei Beni Architettonici per la Conservazione*. Roma: Edizioni Kappa, 2000, p. 33-57. ISBN 9788878903779
- [6] PIOVANO, Alessandro. Santa Giustina di Sezzadio. Storia e rilievo di una architettura medioevale. M.Sc. Thesis in Architecture, Politecnico di Torino.A. A. 2017-2018. Supervisor: Prof Carlo Tosco. Advisors: Prof. Silvia Beltramo, Prof. Fulvio Rinaudo, Prof. Roberta Spallone.
- [7] PORTER, Arthur Kingsley. *Lombard Architecture*. London: Oxford University Press, 1917, p. 425-427.
- [8] BRUSAPORCI, Stefano. Architetture cistercensi nell'Abruzzo aquilano. Misure, geometrie, proporzioni / Cistercian Architecture in the L'Aquila region of the Abruzzi. Measurements, geometries, proportions. *Disegnare. Idee. Immagini*, 2011, 43: 36-45.
- [9] VILLARD DE HONNECOURT. *Livre de Peinture*. J.B.A. LASSUS (Ed.). Paris: Imprimerie Imperiale, 1858.
- [10] BECHMANN, Roland. *Le radici delle cattedrali*. Milano: Mondadori, 1989. 320 p. ISBN 9788804319740
- [11] BERTOCCI, Stefano, BINI, Marco. Manuale di rilievo architettonico e urbano. Torino: Città Studi Edizioni, 2012. 436 p. ISBN 9788825173628
- [12] PAGNANO Giuseppe. *La lettura critica: analisi di cinque opere di Adolf Loos*. Catania: Istituto Dipartimentale di Architettura e Urbanistica dell'Università di Catania, 1975.
- [13] DOCCI Mario. *Disegno e analisi grafica*. Roma-Bari: Laterza, 1987. ISBN 9788842101987
- [14] BERTOCCI, BINI, cited, p. 219.
- [15] STOUFFS, Rudi, TUNÇER, Bige. Typological Descriptions as Generative Guides for Historical Architecture. *Nexus Network Journal*, 2015, 17.3: 785–805.
- [16] EILOUTI, Buthayna, AL-JOKHADAR, Amer. A Generative System for Mamluk Mandrasa Form Finding. *Nexus Network Journal*, 2007, 9.1: 7–30.
- [17] VITALI, Marco. 3D Parametric Models for 'Planterian' Vaults in Turin. *Nexus Network Journal*, 2017, 19.2.: 301–321.
- [18] LO TURCO, Massimiliano, MATTONE, Manuela, RINAUDO, Fulvio. Dal rilievo metrico all'HBIM per l'analisi dello stato di conservazione della fabbrica. *Ananke*, 2017: 141-146.

Table of content

- P 12** Preface
Carmine GAMBARDELLA
- 13 ID 004**
Drawings and Paradoxes: The Image and the Three Fictional Dimensions of Architecture
Pedro António JANEIRO
- 19 ID 006**
Reconstruction, Addition, Grafting, Overlapping and Subtraction. Five Approaches to Intervention in Historic Contexts
Antonello MONACO
- 23 ID 009**
The knowledge as an instrument for recovery and valorize the rural architecture in Sicily
Andrea D' Amore
- 34 ID 011**
An evaluation on how to implement the Historic Urban Landscape (HUL) approach in a critical case study: the city of Valparaíso, Chile
Andrea ORTEGA
- 43 ID 012**
From recovery manuals to historic and construction BUILDING INFORMATION MODELLING (H-BIM). Strategies for historical sicilian centres
Tiziana CAMPISI, Daniela SIDELI
- 53 ID 013**
SWOT analysis for the redesign of historic university building stock
Simone LUCENTI
- 62 ID 014**
Metric survey and possible representations of Historic Architectural Heritage: the case of the Santa Giustina Abbey
Alessandro PIOVANO, Fulvio RINAUDO, Roberta SPALLONE
- 71 ID 017**
Research and design in the area of Early Christian basilicas in Cimitile
Pasquale MIANO
- 81 ID 018**
The landscape as a testimony, or a resource for the future?
Nadia FABRIS
- 87 ID 019**
The newly founded centers in the Agro Pontino: from the local to the global, from the past to the contemporary, to the future
Alberto BUDONI, Maria MARTONE
- 97 ID 020**
Conversions and Resilient Materials
Emanuele Walter ANGELICO

Table of content

- 104 ID 021**
Analysis of Masonry Ancient Neapolitan Helical Staircases
Francesco FABBROCINO
- 112 ID 022**
Recomposition of architecture in the historical city. The San Bernardino area in Padua, Italy
Enrico PIETROGRANDE, Alessandro DALLA CANEVA
- 122 ID 023**
Facades of Krakow's townhouses from the turn of the 19th and 20th century – protection and restoration
Beata MAKOWSKA
- 131 ID 024**
Sustainable rehabilitation and reconversion of Palácio da Rosa (Lisbon) in a dance school
Sara CARVALHO, António LEITE, Jorge RIBEIRO
- 141 ID 025**
Change of urban landscape in correlation with archaeological heritage in contemporary Serbia and knowledge
Natasa ZIVALJEVIC-LUXOR, Nadja KURTOVIC-FOLIC, Hartmut PASTERNAK
- 153 ID 026**
The recovery of illegal settlements: a case study
Claudia de BIASE
- 162 ID 027**
Piazza Medaglie d'Oro and the Vomero hill in the Società pel Risanamento's projects in Naples. 1885-1964
Elena MANZO
- 172 ID 028**
The cycle highway RS1 in Essen: a model of green-oriented mobility to promote urban history
Ilaria PONTILLO
- 177 ID 031**
A place for technology transfer and digital techniques applications for survey and representation: the ancient fort of Nagaur in Rajasthan, India
Minakshi JAIN, Pietro MASSAI, Luca ROSSATO
- 187 ID 032**
The Chinese house inside the ex-foreign concession in Hankou: description of Lifen
Francesco MAGLIOCCOLA
- 197 ID 033**
Literature as a representation of changes in urban landscapes after 1945 (on Polish, Czech and Slovak examples)
Joanna CZAPLIŃSKA

Table of content

- 203 ID 034**
App and Go Edutainment for Micro_Cities on the Sicilian Ionian Coast
Marinella ARENA
- 212 ID 037**
Traditional Knowledge of Disaster-Resilient Design in World Cultural Heritage, Japan - For Consisting Cultural Conservation and Disaster Mitigation -
Takeyuki OKUBO
- 220 ID 039**
Geo-climatic applicability of sunspaces in European climates including resilience to climate changes
Giacomo CHIESA
- 229 ID 040**
Design of indoor climate-control passive systems in buildings: experiences for a PhD course
Giacomo CHIESA, Mario GROSSO, Mehrnoosh AHMADI, Matteo BO, Giovanni MURANO, Marianna NIGRA, Elisa PRIMO
- 239 ID 041**
The Sanctuary of Castel Petroso: reflections on architectural representation
Piero BARLOZZINI, Fabio LANFRANCHI
- 247 ID 042**
Abandoned Railways and Cultural Heritage. Networks for spread regeneration
Francesca CASTAGNETO, Stefania DE MEDICI
- 257 ID 044**
Innovative instruments of territorial environmental management: the need for a regulatory approach
Michele RUSSO
- 263 ID 045**
The Redesign of Boundary between River and Ground. A Technological-Environmental Approach for the Resilience of River Corridors and Health of Inhabitants
Michele DI SIVO, Filippo ANGELUCCI, Cristiana CELLUCCI, Daniela LA-DIANA
- 272 ID 046**
To save from oblivion and destruction. A historical-juridical perspective on the cultural heritage's protection
Maria NATALE
- 280 ID 047**
Structural morphology of the oldest Church in Capocastello (AV)
Ingrid TITOMANLIO

Table of content

- 288 ID 048**
Seismic safety evaluation and push over analysis of the oldest church in Capocastello (AV)
Ingrid TITOMANLIO, Giuseppe FAELLA, Vito IANNACCONE
- 297 ID 049**
Ancient roads of Southern Etruria: historical evolution and digital investigation
Michele MAGAZZU'
- 304 ID 050**
PCM in the energy redevelopment of social housing
Frida BAZZOCCHI, Vincenzo DI NASO, Ilaria TORTORELLA
- 314 ID 051**
The Visibility of the Monumental Heritage and the Network Society
Matteo Giuseppe ROMANATO
- 323 ID 052**
Ziride and Hammadite palatial architecture and its influence on Norman architecture in Sicily
Lamia HADDA
- 333 ID 054**
A spatial multi-criteria analysis model to identify intervention strategies for the recovery of abandoned olive groves. The case study of Lucca Hills
Simona BONELLI, Massimo ROVAI, Maria ANDREOLI
- 343 ID 055**
Landscape redevelopment as a tool for the enhancement of rural areas. A project proposal for the case study area of Padule di Bientina (Lucca – Italy)
Silvia MICHELOTTI, Massimo ROVAI, Maria ANDREOLI
- 353 ID 056**
The reconstruction of an Image. The experiences of Quaroni and Piacentini in Basilicata
Antonio BIXIO, Giuseppe DAMONE, Enza TOLLA
- 361 ID 057**
The aggregation of the building elements in horizontal structures
Francesco Pio ARCELLA
- 368 ID 058**
New trends in local government policies: between the need for reducing land consumption and participatory urban regeneration models
Marco CALABRO'

Table of content

- 376 ID 059**
The main pillars reconstruction of the Basilica di Collemaggio
Alberto FRANCHI, Pietro CRESPI, Marco ZUCCA, Nicola GIORDANO, Nicola LONGARINI
- 383 ID 060**
The Promotion of the cultural heritage: brand new challenge, same old problems
Antonio LIGUORI
- 389 ID 061**
The earthen architecture culture and Campidanese house. Strategies for recovery and enhancement of the Quartu Sant'Elena's Old Town Centre
Alessandra PUSCEDDU, Mario CERASOLI
- 399 ID 062**
Sicilian rural borghi, urban and architectural entities between concreteness and immateriality
Alberto GNAVI, Silvia Maria RIPA
- 409 ID 064**
The built heritage copied and replicated. Reproduction processes of the urban heritage: transcription, restitution and displacement
Giuliana QUATTRONE
- 417 ID 065**
The built heritage copied and replicated. Reproduction processes of the urban heritage: transcription, restitution and displacement
José Miguel SILVA
- 427 ID 068**
The role of Italian cultural heritage in sustainable urban regeneration. New references from four case studies
Francesca ACCICA, Irene POLI, Chiara RAVAGNAN, Francesca ROSSI
- 436 ID 069**
Smart Heritage Strategy: a new intelligence for resilient historical centers
Chiara AMATO, Giulia BEVILACQUA, Silvia URAS
- 446 ID 070**
An inclusive approach to Digital Heritage for knowledge and conservation of European assets: the INCEPTION project
Federica MAIETTI, Federico FERRARI, Marco MEDICI
- 456 ID 071**
"The commercial relations between Great Britain and the Kingdom of the Two Sicilies in the XIX Century"
Vincenzo PINTAUDI

Table of content

- 467 ID 072**
“The Value of Social Media for Reconstructing Lost Heritage in the British Overseas Territory of Montserrat, Site of an Ongoing Volcanic Crisis.”
Gracelyn CASSELL
- 477 ID 073**
Architecturale experiences in the churches of the foundation centers of the “Opera Nazionale per i Combattenti”
Riccardo SERRAGLIO
- 487 ID 074**
Functional behaviours in the requalification of public residential buildings
Carla CHIARANTONI
- 495 ID 076**
Observing urban landscapes. View-points for the representation of contemporary city
Antonella SALUCCI, Niccolò SARDO, Marta MAGAGNINI
- 505 ID 077**
The Design to valorise local tradition in exhibitions for future generation
Laura GIRALDI, Isabella PATTI
- 512 ID 080**
Made in stone
Agnieszka KOSIK WOLNY
- 521 ID 083**
Integrating governance of the National Reserve of Coyhaique, Chile, into regional sustainable development
Theresa TRIBALDOS, Stephan RIST
- 529 ID 084**
Increasing resilience of Cultural Heritage Assets: the “BIMtoBAcademy” project
Marcello BALZANI, Fabiana RACO, Theo ZAFFAGNINI
- 535 ID 085**
Enjoyment of the Cuban Contemporary Architectural Heritage: an innovative cultural visitor route to connect the UNESCO site of Old Havana to the National Schools of Art
Cristina COSCIA, Rocco CURTO, Valeria GADALETA, Jorge PEÑA DÍAZ, Diana ROLANDO
- 545 ID 086**
Applying Resilience Thinking for the Cultural Landscape of the inner areas: new tools of knowledge and adaptive management
Maria Rita PINTO, Katia FABBRICATTI, Lucie BOISSENIN

Table of content

- 555 ID 087**
The complex dialogue between contemporary language and preservation of the ruins in the restoration of Paul II's fortress at Cascia
Stefano D'AVINO
- 563 ID 088**
Landscape analysis of railway structures in heritage assessment: Bridges on the Victoria-Temuco railway line
Ignacio BISBAL GRANDAL, Françoise Anais LOUBIÈS, Nicolás Andrés MORAGA HERRERA
- 573 ID 090**
Architectural Representation: a Tool for Urban Regeneration The Colour Plan of Egadi Islands
Angela Alessandra BADAMI
- 583 ID 091**
From the traditional to the virtual museum: a strategic cultural, social, environmental and economic resource for Europe
Cristiana CARLETTI
- 594 ID 092**
Wedge-shaped bricks spires and domes. Construction and decorative aspects
Francesco DI PAOLA, Giovanni FATTA, Calogero VINCI
- 606 ID 093**
Pottery from the south-west area of the Castle of the Monte in Montella: the decorative repertoire
Iolanda DONNARUMMA, Gaetana LIUZZI
- 617 ID 097**
Principles of cultural landscape Restoration
Sara POURYOUSEFZADEH
- 626 ID 098**
The representation of complex systems. New communication strategies
Maria Elisabetta RUGGIERO
- 633 ID 100**
How the historical heritage affects the urban flow of people? The case study of Lecco
Mattia ALBERGANTI, Chiara BONAITI
- 642 ID 101**
The tomb of Henenu, Luxor, Egypt: underground surveying
Ernesto ECHEVERRÍA, Flavio CELIS, Antonio MORALES, Fernando da CASA

Table of content

- 651 ID 102**
The preservation of the architectural heritage of the twentieth century: the laminar structures of reinforced concrete
Monica MARTINEZ, Ernesto ECHEVERRIA, Gonzalo GARCIA-ROSALLES, Kevin MORENO
- 659 ID 104**
Decline and Resilience of a Mediterranean City: the Case of Syracuse during Thirteenth Centuries
Elina GUGLIUZZO
- 665 ID 105**
The Sanctuary of Santa Maria delle Grazie at Fornò: studies for the restoration and seismic strengthening
Alberto CUSTODI, Nicola SANTOPUOLI
- 675 ID 106**
Urban design and sprawled archaeology. From the “ancient vs new” dichotomy to pre-existence as design material
Raffaele SPERA
- 684 ID 107**
Material and immaterial heritage as a strategic resource facing structural shifts: the case of the Fès-Meknès region (Morocco)
Letizia DI PASQUALE, Maria Rita GISOTTI
- 694 ID 109**
Derna: a gateway of Libya. The ethical value of identity and the vision for the birth of a new urbanity
Calogero MONTALBANO
- 704 ID 110**
“...But what use is this art history?”
Anna MANDIA
- 709 ID 111**
The representation for the use of hidden heritage: the case of Genoese artificial caves
Massimo MALAGUGINI
- 719 ID 112**
The color of the city. Restoration and conservation of the painted facades of Palazzo Boschetti-Dalanzo then Avagnina in Carrù
Maria Paola MARABOTTO
- 728 ID 113**
A Resilient Environmental and Social Design Strategy
Francesca MUZZILLO, Fosca TORTORELLI

Table of content

- 732 ID 115**
Natural disaster and environmental risks. Facts, needs and challenges in Italy
Benedetto DE VIVO
- 738 ID 116**
Ductility-based incremental analysis of masonry structures strengthened with composites
Giancarlo RAMAGLIA, Francesco FABBROCINO, Gian Piero LIGNOLA, Andrea PROTA, Gaetano MANFREDI
- 747 ID 117**
The technology of reinforced concrete elements.Determination of project parameter: concrete cover
Roberto CASTELLUCCIO, Maria INFANTE, Veronica VITIELLO
- 757 ID 118**
The “Cartilla de mantenimiento” as a tool for the protection and maintenance of the earthen architectural heritage in Tunja, Colombia
Elena ZANET, Francesca DE FILIPPI
- 767 ID 119**
The Deception of Colour: Digital Reconstruction of finctae et pictae Architectures
Gabriella LIVA
- 776 ID 120**
The role of overstrength in damage propagation and monitoring of architectural heritage
Bernardino CHIAIA, Antonio VENTURA
- 783 ID 121**
ICTs to train on World Heritage and Tourism: the case of “Tourism Management at UNESCO World Heritage Sites” MOOC
Ilaria ROSANI, Silvia DE ASCANIIS, Maria GRAVARI-BARBAS, Lorenzo CANTONI
- 792 ID 122**
Local identities & excellences. An industrial network to re-produce uniqueness through waste reutilization
Elisabetta BENELLI, Laura GIRALDI, Francesca FILIPPI, Jurji FILIERI
- 799 ID 123**
Sinkhole hazard in the metropolitan area of Naples,Italy
Anna SCOTTO DI SANTOLO, Melania DE FALCO, Giovanni FORTE, Antonio SANTO
- 807 ID 124**
A requalification project hypothesis for the Bagnoli/Agnano (Naples, ITALY) ex NATO Headquarter Area
Mariateresa RUGGIERO

Table of content

- 816 ID 125**
Strategy to re-active an urban landscape
Valeria SCAVONE
- 823 ID 128**
Two outstanding examples of vernacular architecture in Talas town, Anatolia
Duygu TURGUT
- 831 ID 129**
Paul Bellot architecture: between resilience and redesign of “sacrum”
Maria Carolina CAMPONE
- 841 ID 133**
Greek Orthodox merchants in Western Mediterranean sea: commercial and canonical matters
Antonio MATASSO
- 845 ID 134**
Protection and Integration of linear watercourse cultural landscape in urban development ----- A case study of Orléans and Yangzhou
Liang PENG
- 857 ID 136**
Russian approaches to estimation and experience of monitoring of radon radiation
Andrey V. VASILYEV
- 862 ID 137**
Approaches and results of estimation of noise impact to the health of population
Andrey V. VASILYEV
- 870 ID 138**
Automobile transport noise modeling and estimation in town conditions
Andrey V. VASILYEV
- 875 ID 139**
Majolica and Architecture. Treatment of the lacune. The case of the bell tower of San Paolo Bel Sito
Saverio CARILLO
- 885 ID 140**
The historical context and the urban regeneration
Federica CAPRIOLO

Table of content

- 894 ID 141**
Typological classification of vaulted structures in masonry churches
Daniela CACACE, Gianfranco DE MATTEIS
- 904 ID 142**
Innovative systems for the redevelopment of historical buildings: BIM application
Simona COLAJANNI, Giusy Emanuela LO CACCIATO, Achille Roberto PORCASI
- 914 ID 143**
Evaluation of the indoor comfort of the Arabic-Norman architecture for its valorization
Simona COLAJANNI
- 922 ID 144**
Structural behaviour of masonry vaults according to architectural types
Gianfranco DE MATTEIS, Daniela CACACE
- 932 ID 145**
Design with Nature: The connection between Critical Regionalism and Biomimicry in a Moroccan village
Pedro MARTINS-MOURÃO, Pedro JANUÁRIO
- 942 ID 146**
Preservation of historic buildings: two examples in Sant'Agata de' Goti, Italy
Annachiara PIRO, Annalaura VUOTO, Filomena de SILVA, Pierpaolo D'AGOSTINO, Fulvio PARISI, Francesco SILVESTRI, Anna SCOTTO di SANTOLO
- 952 ID 147**
Sports Architecture: the soccer stadiums of the twentieth century in Brazil and Portugal
Beatriz ATTA, Pedro JANUÁRIO, Jorge BOUERI, João SOUSA MORAIS
- 960 ID 148**
Data taking and quality control for complex surveys: Case study Sagrada Família
Juan CORSO, Jordi CASALS, Adria MARCO, Daniel LÓPEZ, Pilar GARCIA ALMIRALL
- 971 ID 151**
Territory visions: dimensions of observing, measuring and returning
Laura FARRONI, Marco CANCIANI, Matteo Flavio MANCINI, Silvia RINALDUZZI
- 981 ID 153**
Reuse or Recycle?
Ludovico ROMAGNI

Table of content

- 989 ID 159**
Survey between protection and orientation of transformations. The case study of Florida
Rita VALENTI, Claudia FARACI, Sebastiano GIULIANO, Emanuela PATERNO, Flavio SPADARO
- 998 ID 160**
Public Buildings accessibility in Fortaleza's Historical Center
Camila BANDEIRA PINHEIRO LANDIM, Pedro Miguel GOMES JANUÁRIO, Márcia Maria VIEIRA HAZIN, Geórgia MORAIS JEREISSATI
- 1009 ID 161**
The museum building and its role in conservation of artifacts in Albania
Etleva BUSHATI, Florian NEPRAVISHATA
- 1019 ID 162**
The use of new technologies in the commemoration projects of the centenary of the apparitions of Fatima
Geórgia MORAIS JEREISSATI, Pedro Miguel GOMES JANUÁRIO, Márcia Maria VIEIRA HAZIN, Camila BANDEIRA PINHEIRO LANDIM
- 1029 ID 163**
The implementation of the Smart City paradigm in complex and user-centric domains
Mariacarla PANARIELLO
- 1037 ID 164**
Traditional games and culture
Antinea AMBRETTI
- 1041 ID 165**
The "Right" to the quality of the "Preservation" for Italian architecture of the Second half of the 20th century
Carla BARTOLOZZI, Gentucca CANELLA
- 1051 ID 167**
Design 4.0. Practices and processes of diffuse and circular design for the enhancement and development of local cultural heritage
Jurji FILIERI, Elisabetta BENELLI, Laura GIRALDI
- 1060 ID 171**
Historic urban centers. Construction characters and seismic vulnerability
Tiziana CAMPISI
- 1070 ID 172**
Internet of things and artificial intelligence technologies preserve cultural heritage
Marin MARINOV, Maria KOKORSKA

Table of content

- 1078 ID 175**
Italian grain silos from the 1930s: inventory, knowledge, conservation and reuse
Stefania LANDI
- 1088 ID 178**
Destructive tests for mechanical characterization of in situ structural timber
Francesco GUARINO, Alberto MANDARA, Gianfranco DE MATTEIS
- 1098 ID 179**
Correlation between NDT results and mechanical strength of structural timber
Gianfranco DE MATTEIS, Francesco GUARINO, Alberto MANDARA
- 1108 ID 180**
From information to knowledge Building new learning strategies in heritage field through graphics and new technologies
Marina PUYUELO, Pedro FUENTES, Mónica VAL
- 1118 ID 183**
Three Schools: Torino, Avellino, Palermo
Efisio PITZALIS
- 1128 ID 184**
Mediterranean Bio-Cultural Landscape: network of expertise
Marina FUMO, Gigliola AUSIELLO, Monica CANNAVIELLO, Antonella VIOLANO
- 1138 ID 185**
Virtual community content sharing to support decision making process in protection, conservation and promotion of cultural heritage and landscape
Antonio TUFANO, Roberto VALENTE, Modestino MATARAZZO, Enza GRAZIANO
- 1148 ID 186**
Design 4.0. Practices and processes of diffuse and circular design for the enhancement and development of local cultural heritage
Caterina GATTUSO
- 1155 ID 187**
Hidden river: recovering the memory of a city
Maria Grazia CIANCI, Francesca Paola MONDELLI
- 1165 ID 188**
The role of evaluation in B.I.M. models: from the representation to the simulation of the design
Giovanna ACAMPA, Fabiana FORTE

Table of content

- 1172 ID 189**
Adaptive and dynamic facade: a new challenge for the built environment
Sergio SIBILIO, Roberta IAVARONE, Simona MASTANTUONO, Maria MANTOVA, Luigi D'AUSILIO
- 1183 ID 190**
Preliminary energy analysis of the school building stock in the Province of Caserta
Sergio SIBILIO, Nicolò FALCIONE, Anna IMPROTA, Antonio ROSATO
- 1191 ID 193**
Post-seismic rebuilding in Irpinia and resilience
Maria Antonietta FALCI
- 1201 ID 194**
A simplified analysis for seismic risk assessment of reinforced concrete school buildings
Gianfranco DE MATTEIS, Pasquale BENCIVENGA, Francesco GUARINO, Carmela NOLA
- 1210 ID 196**
The Mudéjar Style: An interpretation key of the Ibero-American Baroque architecture
María Fernanda GARCÍA MARINO
- 1220 ID 197**
The rediscovery and enhancement of the historical "Wool Road" through its recognition and reuse project
Paola CONDOLEO, Andrea ROLANDO, Daniela ORENI, Alessandro SCANDIFFIO
- 1230 ID 198**
Sewell mining settlement: Construction of a unique landscape as an adaptive process to a complex and hostile territory
María Dolores MUÑOZ, Ignacio BISBAL
- 1240 ID 200**
REDESIGN + RESILIENCE= Stories of Alternation
Maria Dolores MORELLI
- 1247 ID 201**
A resilient pedagogy. The LANDesign® Project for "school-work alternation"
Enrica PAGANO
- 1256 ID 202**
Know to preserve: Archaeological remains of the triconch architectures in Turkey
Danila JACAZZI, Raffaella FIORILLO

Table of content

- 1264 ID 203**
Green infrastructures and Eco-Planning: the Aversa conurbation
Salvatore LOSCO
- 1274 ID 204**
A New Role of Museums in Industrial Type Cities and Renovation Programs for the “Center-Periphery” Opposition: the Case of the Museum Quarter Togliatti Concept
Elena SHLIENKOVA, Elena SPERK
- 1285 ID 205**
Documenting the Architectural Heritage. From the survey to the three-dimensional modelling
Pamela MAIEZZA
- 1293 ID 206**
The connection between the Architectural Roman heritage and the Theory of Nodes as a management tool
Isabel TORT AUSINA
- 1302 ID 207**
Productive green in the city: opportunities for eco-oriented transformations
Raffaella DE MARTINO, Barbara DI VICO, Rossella FRANCHINO, Caterina FRETTOLOSO
- 1313 ID 208**
Aldo Rossi: Berlin, 1960-1997
Maria Luigia DI BENNARDO
- 1322 ID 211**
The Real Estate Fund for the redevelopment of Public Administration Properties
Francesco VERDE
- 1331 ID 212**
Complex Representation of Knowledge
Gilda EMANUELE
- 1335 ID 226**
Designing the resilience. A masterplan for the Opportunity Areas of Bromley
Giovanni BELLO
- 1341 ID 230**
The evolution of information disclosure through the Open Institutes
Luciana ABATE

Table of content

- 1351 ID 231**
Knowledge and representation between ethics and aesthetics
Rosaria PARENTE
- 1361 ID 232**
The Future of Representation: parametric modeling in the HBim environment
Giuliana CHIERCHIELLO
- 1371 ID 270**
Representing World Heritage properties, cultural landscapes and contemporary architectures: Amsterdam and Rotterdam
Alessandro CIAMBRONE
- 1382 ID 271**
Itineraries of urban identity
Isabella PATTI



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