Romanian Court Residences

The Potlogi Palace: History and Virtual Recording as Restoration Tools

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Romanian Countryside Residences

The court residences in Walachia – the historical province situated in the Southern part of Romania – constitute an important chapter of Romanian architectural history and heritage. Studies of their development in the seventeenth and eighteenth centuries have regarded their architecture as a response to political and economic conditions and to their owners' social need for representation.

Walachia was established as an independent state at the beginning of the fourteenth century. Until the end of the sixteenth century, the ruling princes' residences – preserved as ruins and archaeological sites – are the only proofs of the existence of secular masonry architecture. There are no traces of such residences belonging to the 'boyars' (Romanian noblemen) in the same period. This changed in the early seventeenth century. New economic opportunities encouraged the boyars to reconsider their countryside properties. They decided to spend the major part of their time there so as to have a better control of their lands. This initiated a very consistent building activity all over the country. Since these residences had an important defensive role the pattern is more or less the same everywhere: all of the approximately sixty court residences built in the seventeenth century are fortified.

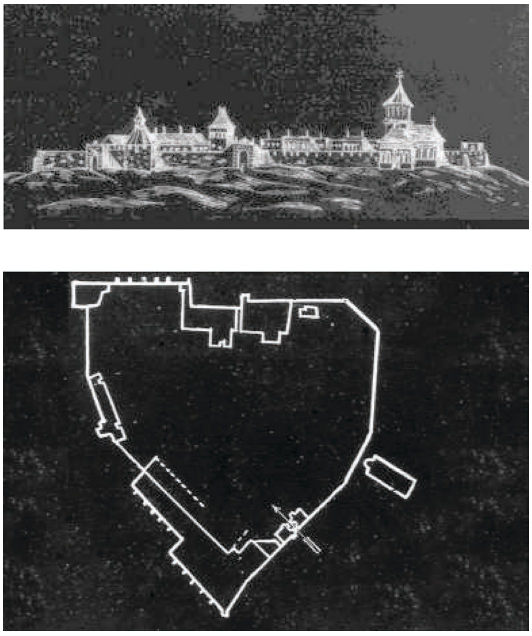

Fig. 1 The court at Brâncoveni, built ca 1634.

Placed on a hillside or on an elevated stretch of land, the large court precinct is enclosed by a wall. The buildings (the house of the landowner, the kitchen, the servants’ building, and other annexes) are placed against this wall and oriented towards the central space, which is left empty in order to shelter the peasants and their goods in the case of an attack. A well is always present in the same space. Sometimes a tunnel offers a possibility to escape in the case of a siege. The chapel of the court is located outside the wall and has its own fortified precinct.

Fig. 2 The ruler prince Constantin Brâncoveanu.

The ruler prince Constantin Brâncoveanu (1688–1714) was the creator of a new pattern for such residences. The palaces he ordered were built to shelter himself, his family and his retinue, corresponding to an itinerary, repeated every year, that connected his Bucharest palace with his summer residence in the city of Târgoviste (the old Walachian capital). Their architecture reflects the prince's requirements regarding the ceremonial and etiquette to be observed by him and his court members. The Potlogi palace, erected in 1698, was the first to present the characteristics of this new orientation; its architectural features constituted the prototype for the court residences built later by the prince.

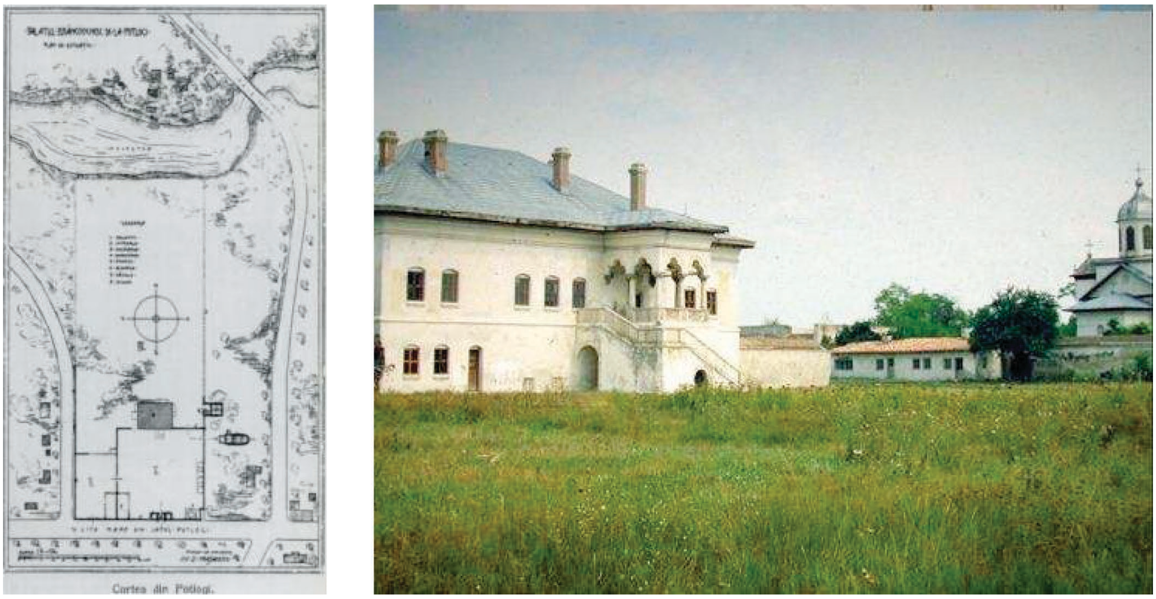

Fig. 3 The Potlogi Palace.

The architectural characteristics of the palace are influenced by contemporary North Italian residences. This hypothesis was put forward eighty years ago by Nicolae Ghica Budesti,[1] based on the known presence of numerous Italians at Brâncoveanu's court, and has been confirmed after studying Italian archives and the literature on residences in the Veneto. Just like its models, the Romanian residence at Potlogi is placed on a flat terrain adjoining a river. A rectangular wall surrounds the court components on three sides, the fourth side being taken up by the river. The house/palace has a central position: the front side faces the entrance yard, which contains also the court annexes; the opposite side has a loggia oriented towards the garden and the water. The court chapel is placed outside the wall in its own precinct. The organization of the spaces inside the palace – from the symmetrical plan and the superimposed loggias to the vaulting system and the carved stone decoration – is inspired by the same models.[2]

Nevertheless, the palace's architecture also bears the marks of an oriental influence, probably from Constantinople. The stucco decoration, both of the interior and the exterior of the building, is clearly inspired by contemporary Ottoman architecture.[3] By contrast, the entrance apparatus (composed by the stairs and the belvedere) and the volume of the palace follow the model of earlier Walachian architecture. It has indeed been demonstrated that the architecture of the Potlogi palace constitutes an original local synthesis, made according to the prince's will.

Fig. 4 Potlogi Palace: images illustrating the assimilation of different influences.

From this point of view, the Potlogi palace instituted a new pattern that changed the face of residential architecture in Walachia. Thereafter the other court residences of the prince used the same compositional principles and decorative elements, and in the next fifty years the Romanian boyars, too, adopted the same architectural characteristics, at a smaller scale, for their own residences.

Virtual Modelling of Historical Architecture: Notes on the (Potential) Reversibility of Restoration

The relationship between virtual modelling and restoration begs an important question: is the reconstruction of a virtual space equivalent to the implementation of a restoration project, or does it belong to the sphere of representation? In other words: to what extent can an immaterial reality affect the critical approach of conservation?

The high sophistication of virtual modelling and simulation techniques prompts us to re-examine the relationship between reality and its representations, by thinking of 'virtual realities' as real worlds. As Bonollo has pointed out: 'Simulation opposes itself to representation, to the *re*-presentation of "that which has been", because it does not restitute a completed past, but refers to potential events, to eventualities, to "something that may be".'[4] 'Simulation' and 'virtuality' therefore constitute two contiguous instances. Simulation occurs when virtuality replicates a real geometry through a synthetic representation. Pure virtuality, by contrast, occurs when one chooses a 'hetero-representation', a more complex metaphor adapted to describing the sense of reality. Or, to quote Forte, 'Whereas simulation simplifies the contents of the real by schematising them (sometimes in a reductive sense), virtuality tends to extend and multiply them'.[5]

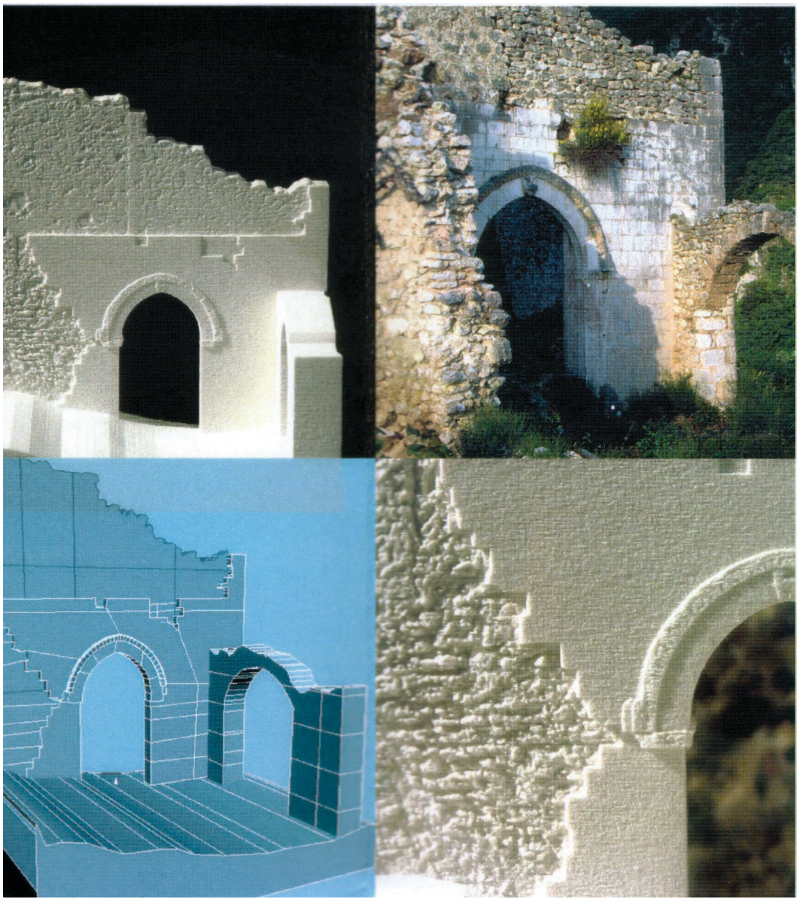

Fig. 5 Santa Maria church, Ancarano Castle (Perugia), 3D model of the façade.

Undoubtedly computer science (and especially its digital survey applications that are conceived for the representation of historical architecture) is the cultural sphere in which one can best discern this duality between tangible and intangible, between real and unreal. This duality amounts to a cognitive and critical exercise that expresses itself in three separate but complementary domains: aesthetics, in so far as the aesthetic values of the artwork are fully rendered by its digital representation; philology, in so far as this representation restitutes also the original meanings and values of the artwork; and conservation, in so far as the digital model represents not just the latest state of conservation but allows to trace back all previous interventions.

The latest virtual technologies make it possible to exploit the memetic abilities and the creative power of virtual reality in every field of human action. The digital processing of an image (if understood as a research method and not just a mere computer application) can significantly improve knowledge: a multiple screening of shots across all wavelengths, the subsequent comparison between the resulting images, and the use of digital techniques to separate texts, can for instance be used to read superimposed layers of text. Likewise, an accurate and critically conducted digital survey of a building can help to identify phases in its historical developments that are otherwise undocumented.

In the field of conservation, computers can be used as effective instruments to examine properties and behaviours of materials, and to monitor the design process in parallel with (or, preferably, in support of) the restoration itself, without affecting the material of the historical document itself. Digital surveys are therefore appreciated more and more as a special form of non-destructive investigation and as tools for a 'pre-diagnosis' of the health of a monument.[6] 'Virtual restoration' therefore seems an ideal instrument to integrate different cognitive means: it increases the legibility of data without acting on the material of the object, so that its impact is reversible at all times.

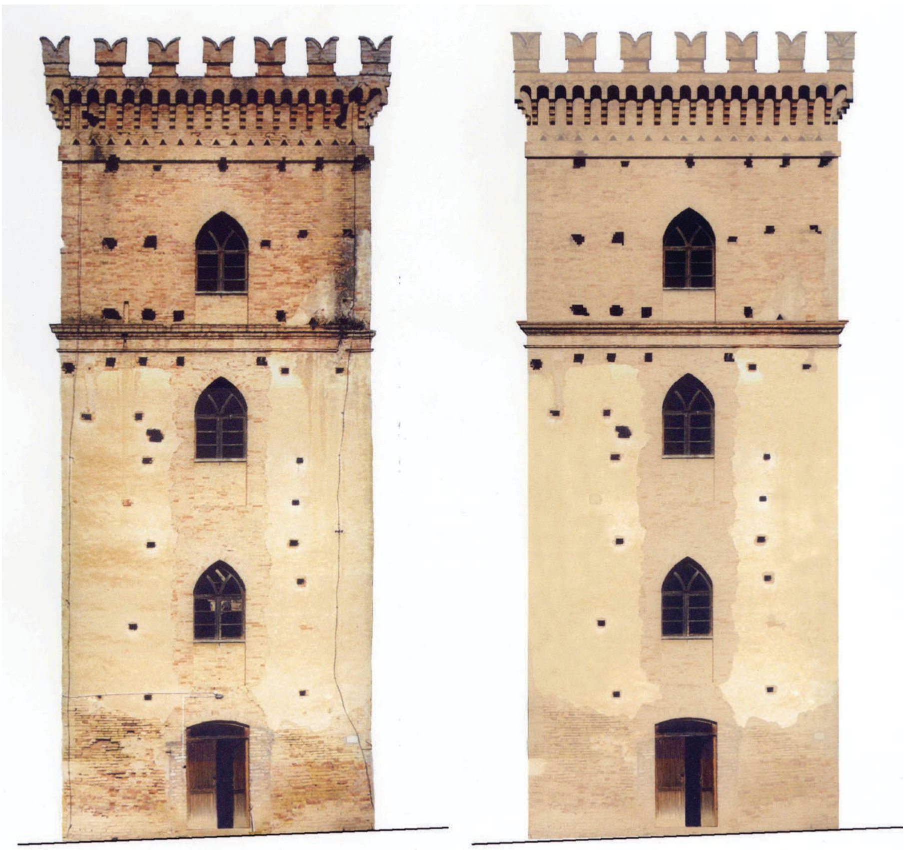

Fig. 6 Sterlich Tower, Spoltore (Pescara), example of virtual restoration.

The main, though not the only, goal of virtual restoration is to reproduce the appearance that the work would have after an eventual cleaning or restoration campaign. As noted by Forte: 'Virtual restoration, conducted not on the material object but on its representation, can yield data which, although present in the original object, are not directly discernible from its present condition. The added value of using virtual reality methods in the field of cultural heritage lies in the possibility of providing experiences, and therefore of initiating cognitive processes, even in the absence of physical (real) objects'.[7]

The use of digital modelling in the field of restoration can therefore serve a double purpose: putting emphasis on the information content of a model may result in a higher gnoseological value, while rendering the model as realistically as possible may also give it a documentary value. The purpose of digitized information, whether images or texts, is therefore not to make up for the inevitable deterioration of the original material, but to preserve at least its form, that is, its diachronically created image, untouched by time.[8]

Fig. 7 St. Augustin church, Cascia (Perugia), example of virtual anastylosis.

The particular prerogatives of the use of computers for the virtual restoration of a lost image or a lost building can be appreciated by looking at their specificities: working with a digital piece of information, one has the greatest freedom: it can be altered and copied countless times without any impact on the material object itself; which has substantial consequences on the principles of restoration: reversibility, compatibility, and minimal impact.

The method of virtual restoration allows simulating interventions while preventively reviewing the results. The process also enables one to try out interventions that are not possible in ordinary conservation practice. Virtual restoration must therefore be seen as parallel and complementary to traditional restoration, and a helpful tool for historical and philological research.

The Potlogi Palace: Digital Drawing and 3D Modelling

A complete study must necessarily start from a correct metric investigation in which the most suitable measurement techniques are integrated. The ultimate goal of these techniques is to analyse the structure and the damages caused by time or by incorrect restoration. By jointly using advanced laser scanning techniques and on-site surveys (conducted by historians and restoration experts), important results can be obtained that improve our understanding of the historical complexity and the construction characteristics of the monument. This information can be used for conservation projects.

The Potlogi Palace has been chosen for this case study for its particular historical and architectural value; it is particularly significant in that it represents an architectural reference model for similar buildings in the region. Because of its unique architectural features and its historical value, the building merited an in-depth survey, which for this reason was planned in two annual sessions, in conjunction with inter-university workshops in 2011 and 2012.

Fig. 8 Potlogi Palace, south-east view.

Fig. 9 Potlogi Palace, north-west view.

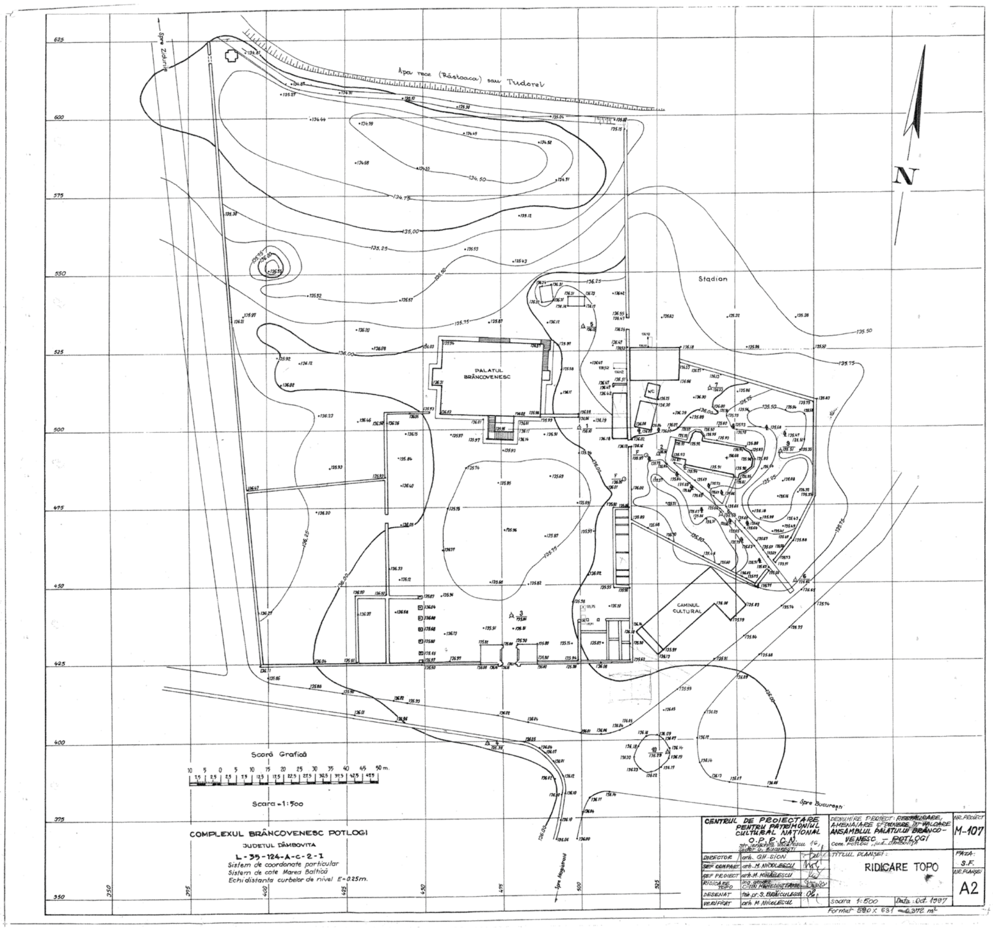

Fig. 10 Planimetric view, 1:500 scale, equidistance between the contour lines 0.25 m.

This paper presents the results of the first metric survey which was carried out in July 2011, on the occasion of a first workshop held in Romania, in which students of both the Gabriele d'Annunzio University of Chieti-Pescara (Italy) and the Ion Mincu University of Bucharest (Romania) participated.

The building presents a seemingly regular geometrical shape, but in reality the structure shows in many details a complex structural pattern, which is due, in part, to various restoration interventions over time. During the first phase of the survey only some parts of the building were examined in order to verify its structural conditions, namely: the fronts (with particular regard for the computation of the inclination of certain wall parts); the system of vaults of the main rooms located on the first floor; the shapes and building techniques and material conditions of the vaults in the large room with central pillar located in the basement.

Fig. 11 Potlogi Palace, entrance.

Fig. 12 Potlogi Palace, interior.

Structural Problems

The large vaults of the rooms located on the *piano nobile* show visible signs of cracks. A geometric study of the crack pattern was carried out as part of the pathology of the structural behaviour of the building. In order to assess whether the cracks could represent a potential cause of instability, it was deemed necessary to investigate in 3D the whole structural system of the main elements (walls, arches, vaults, pillars) that play a determining role in the static equilibrium of the building. The anomalies of the building, detected using a 3D digital model, could help researchers to arrange a monitoring plan of the relevant parts of the structure. Laser scanning techniques allowed to quickly build a digital 3D model with a high level of detail. Topographic and laser scanner surveys were useful to investigate relevant structural problems. The data gathered during the surveys were converted into a 3D polygonal surface (mesh). This numerical model was then used to investigate the structural aspects of the building, so that a diagnosis on the status of the building could easily be effectuated.

Survey Campaign

The survey campaign was planned with the goal of obtaining an accurate 3D model that could yield measurements, plans, profiles, sections and orthophotos on a 1:50 scale. Profiles and sections (directly obtained by slicing the 3D model) were needed to highlight and evaluate the inclined wall.

Modern high-definition laser scanning is able to generate 3D models with millions of points of the surveyed building. The recent development of laser technology finds significant applications in terrestrial scanning systems. These instruments collect point clouds with reference fields of almost panoramic views and make use of sophisticated servomechanisms for the management and control of micro-movements. The point clouds are organized in a matrix that contains the spatial position of these points, the colour information (RGB), and the reflectivity level of surfaces. The acquisition time for a panoramic scan (the one used for the measurement campaign is 360° × 305°) is about ten minutes. It provides a sampling of very high density. The 3D model is then formed by the appropriate aggregation of the various point clouds. The scan locations must be selected to offer the widest visibility of the surfaces of the object of interest, minimizing the areas that are occluded or in the shade. Problems related to occlusion and visibility represent, in fact, the main cause for lack of information and may lead to gaps in the point clouds.

The survey process was organized according to the following procedure, which can be subdivided in three subsequent phases of operations:

1. Data acquisition: Survey plannig, field operations
2. Data management: Data preparation, data registration, data processing
3. Quality control and delivery

Description of the Building

The building, rectangular in shape, has four levels, and is composed of a total of 28 rooms. In the basement there is a single large room with four vaults and a central pillar; the ground floor consists of ten rooms; and the main floor has fifteen vaulted rooms. The attic, a complex structure made of wooden lintels, visible in the 3D reconstruction (fig. 6), will be studied in the next measurement campaign. The building is approximately 32 m long, 23 m wide and 17 m high (from the ground floor up to the top of the roof). The perimeter wall is 9 m high. As far as the measurement campaign is concerned, the area surrounding the building is basically unobstructed as it does not include the presence of trees or other obstacles that could cause occluded areas in the scan data.

3D Preliminary Quick Modelling

Starting from available paper plans and sections at scale 1:50 (figs. 13–16) it was possible to generate a simplified 3D model of the building. This was made to facilitate the operations of the on-site survey campaign via a simple operation of raster-vector transformation based on the extrusion of closed polylines in order to obtain spatial information that is simple to handle in AutoCAD. This quick modelling exercise allows an initial understanding of the volumes, the surfaces and the positions of the apertures. The quick 3D model obtained from 2D orthographic views was very useful in designing and distributing the planar and spherical targets, and in choosing the most suitable positions of the scan points.

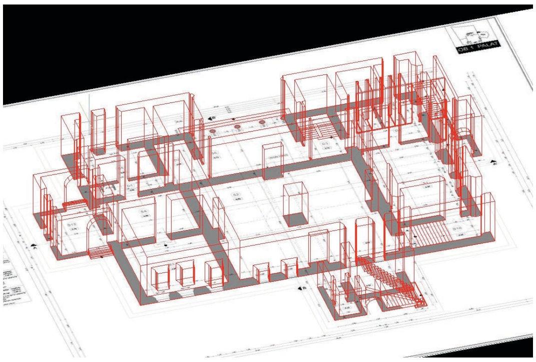

Fig. 13 Axonometric view of the model (wire frame).

Fig. 14 Axonometric view of the model (shaded).

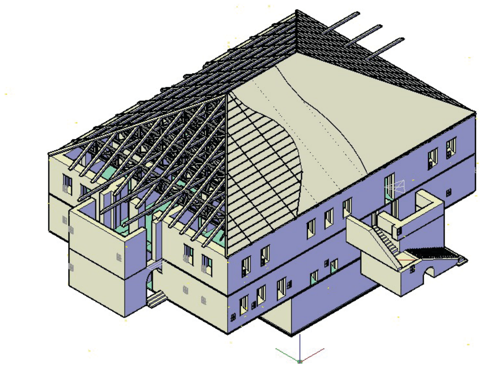

Fig. 15 Axonometric view of the whole solid 3D model.

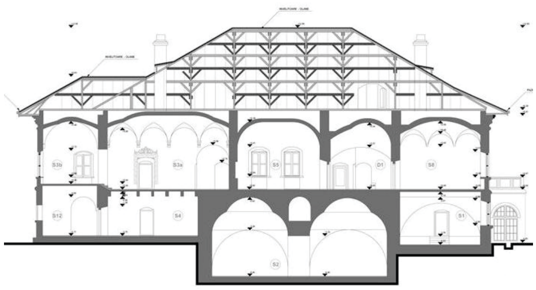

Fig. 16 Longitudinal section (available drawing) used to realize the row solid 3D model.

The 3D reconstruction (fig. 15) allowed us to create a model based on the available original drawing and with the help of photographs taken at the initial stage of the measurement campaign. The wooden roof structures have also been digitized and they can be shown in AutoCAD, either together with the roof covering (tiles, lead, etc.), or without the covering so as to display the rafters and trusses.

Instruments and Software

A Leica reflectorless total station TCR407 was used to set up the closed polygonal reference system (figs. 19, 22, 23) and to coordinate the target points (natural and artificial) around and on internal surfaces of the building. The laser scanning was conducted using a Faro Focus3D, a mid-range scan phase-based measurement system, with a stated range of 120 m. The scanner has an integrated

2-megapixel colour camera that is coaxial with the laser. It produces a 70-megapixel colour overlay using 84 photos to cover the field of view (360° × 305°). The collected data are stored on an SD card. Thanks to the compact size and light weight of the unit it was simple to transport by plane or car and easy to operate in difficult access conditions (staircases, narrow spaces). The Focus3D uses spherical targets (fig. 18) in addition to planar targets. FARO's Scene software automatically detects the sphere targets and registers multiple setups together.

The completeness of 3D point clouds represents a secure advantage over other sources of geometric information, but contrasts with the complexity of the management of millions of points; therefore the choice of the software used for processing the point clouds plays an essential role in laser scanning techniques. We used Leica Cyclone to process the external laser-scan data, FARO's Scene to align and register the internal scans, Rapidform XOR to extract from the 3D model the cross-section polylines and export them in DXF file format. Drawing up the elevations, plans, sections and final CAD drafting was completed with AutoCAD.

Fig. 17 3D indoor laser scanner survey operation.

Fig. 18 3D outdoor laser scanner survey operation.

The external and internal surfaces of the building were surveyed using topographic and laser scanning methods. In order to arrive at a precise geometrical correspondence between the data collected in each measurement system, a preliminary topographic survey was carried out. The topographic survey provides the definition of the reference system that is the basis for all the observations made, in addition to being the support of the laser scanning survey.

Topographic Network

The network consists of 12 vertices: 6 external ones, materialized by topographic nails, and 6 internal adhesive targets, which can be easily removed without damage to the surface. The measurement of the resulting closed traverse of 230 meters length has been carried out by means of a Leica TCR 407 total station.

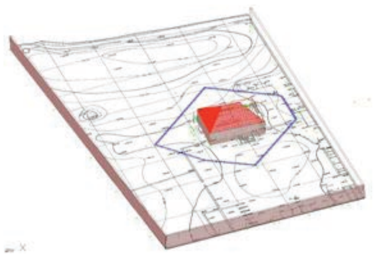

Fig. 19 Axonometric view of topographic network superimposed on map of environment.

Fig. 20 Total station set up.

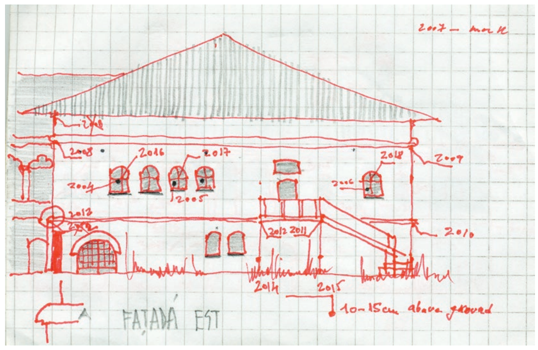

Fig. 21 Sketch traced during the topographic campaign.

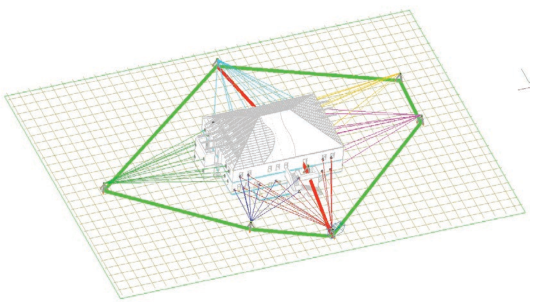

Fig. 22 Axonometric view of the network (grid spacing 3 m).

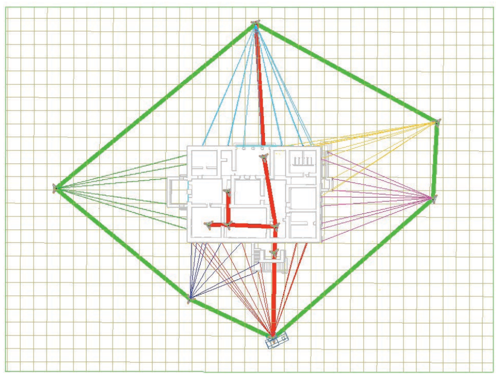

Fig. 23 Planar view of the Potlogi Palace, showing the layout of the geodetic network grid spacing 3 m. The green polyline shows the connections between the external vertices. In red the connections between the internal vertices.

In the second stage (which will be executed in July 2012), thanks to static GPS measurements, the local network will be linked with two points of the national reference system.

The point cloud acquisition phase is strongly conditioned by the shape, the dimensions, the required level of detail and the expected precision. In our case the scale of the final delivery material is 1:50.

Scale	Effective point density	Precision of measurement
1:50	5.0 mm	± 5.0 mm

Fig. 24 Relations between scale, point density and precision of measurements.

Taking into account that the beam width of the measurement equipment shall not be greater than the double of the effective point density and that the expected precision has also been established, we can define the operational range of the measurement operations, the setting parameters and the scan points.

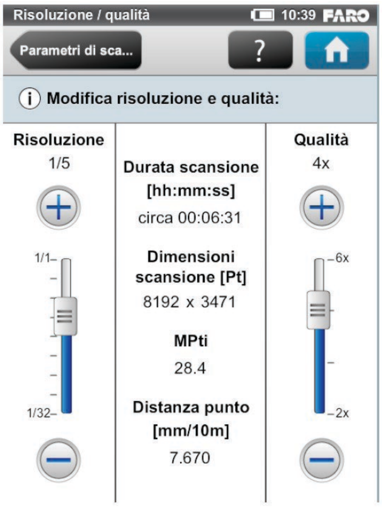

Fig. 25 Focus3D, setting of parameters on a touchscreen, quality and resolution panel.

Scan Point Planning

Care was taken to plan the standpoints of the scanner in order to obtain a high level of overlap between each scan and to ensure the appropriate data resolution, thus facilitating the subsequent drawing task. The individual scanner setups were positioned, where possible, at equal distances from the surfaces of the building and from each other; 28 scan points were placed: 12 around the building (fig. 26) for the definition of the fronts, 8 in the rooms of the basement and ground floor, and 8 on the main floor (fig. 27).

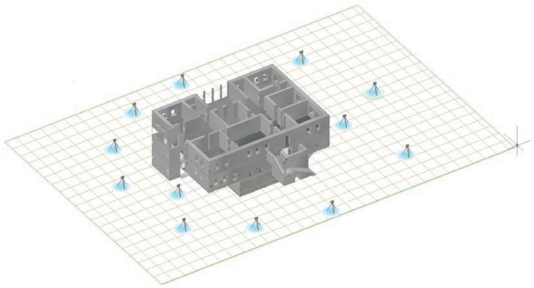

Fig. 26 Axonometric view of the model of Potlogi Palace, with layout of external laser scanning standpoints, grid spacing 3 m.

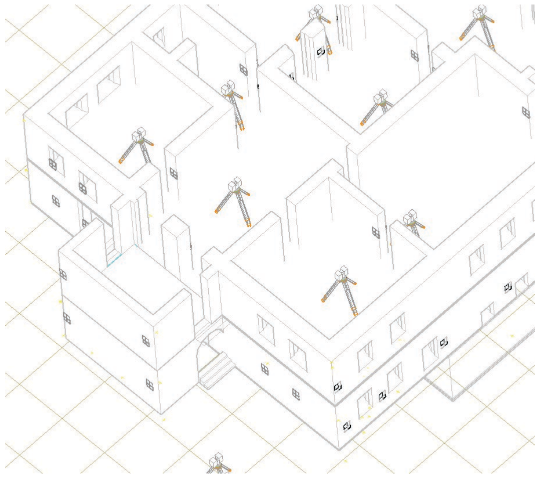

Fig. 27 Axonometric view of 3D digital model, with layout of internal scanning standpoints and planar target network.

Data Management

The data set gathered during the survey campaign was stored into a database application that enables the following data processing phases. The scans were registered using homologous points finalized to obtain a complete 3D digital model of the building (interior and exterior). The targets, detected automatically by laser scanner, were surveyed with a topographical station. Using coincident points it was possible to roto-translate the point cloud model into a topographic network and so to manipulate the model into an oriented 3D digital workspace. The set of the oriented scans were merged into a single point cloud model in order to remove overlapping areas. The entire point cloud model was broken down into several parts; each part was filtered to reduce noise, decimated, and then converted into a polygonal model. The polygonal models were handled using reverse engineering applications in order to obtain measurable sections and 3D views that are able to represent the shape and the state of conservation of the building (figs. 34, 37).

First Results of the Survey

The following illustrations show some examples from the first phase of the survey.

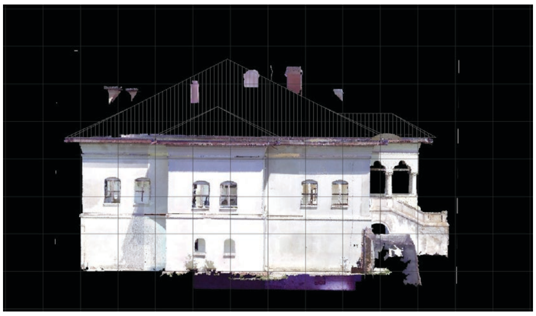

Fig. 28 West elevation (grid spacing 3 m).

Fig. 29 South elevation (grid spacing 3 m).

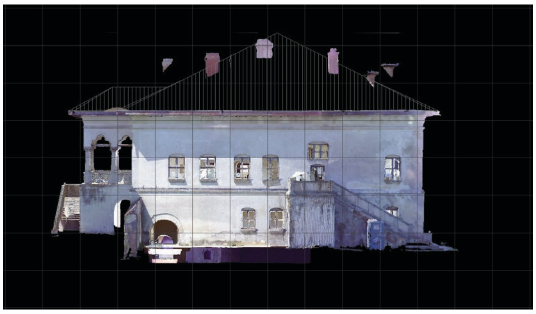

Fig. 30 East elevation (grid spacing 3 m).

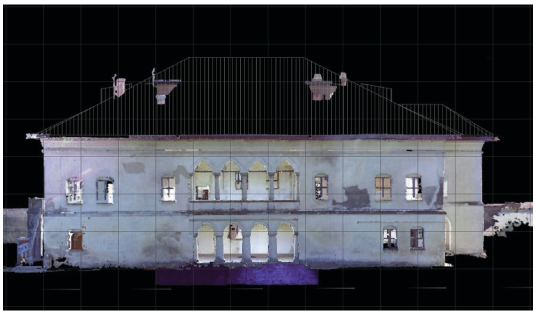

Fig. 31 North elevation (grid spacing 3 m).

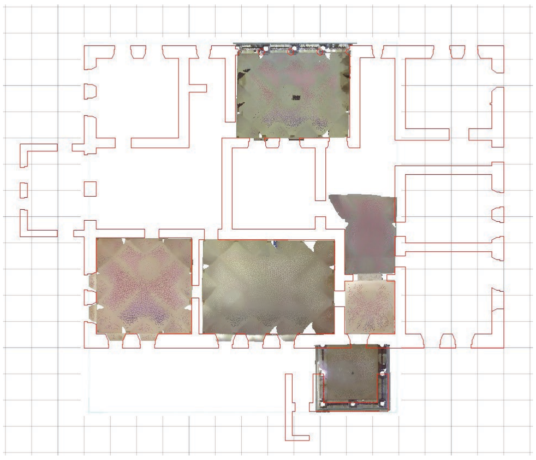

Fig. 32 Plan of the investigated vaults of the first floor.

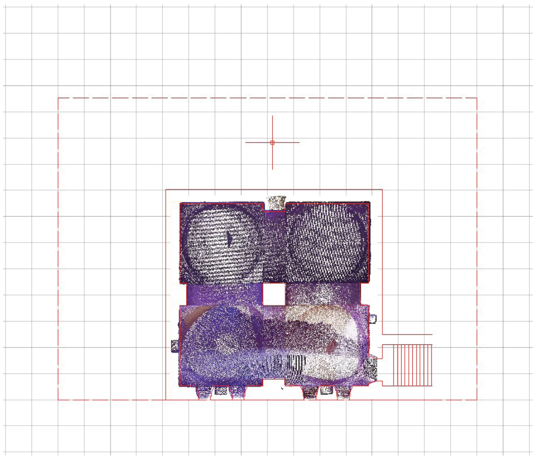

Fig. 33 Plan of vaults at the basement.

3D Meshed Model

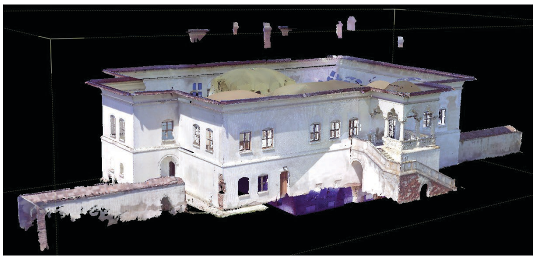

Fig. 34 3D meshed model, south-west view.

Fig. 35 Potlogi Palace, south-west view.

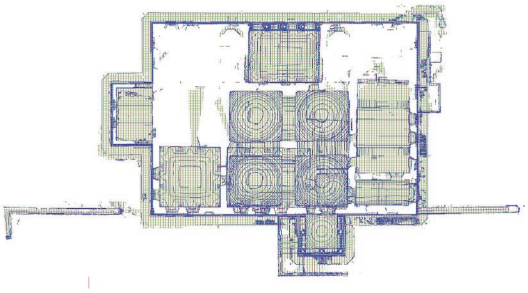

Fig. 36 Plan view of the set section (distance between sections 0.25 m).

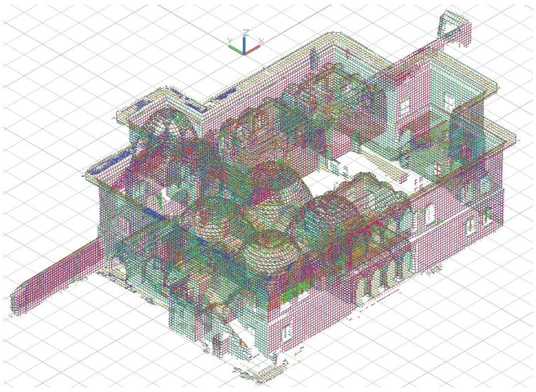

Fig. 37 Axonometric view of the cross-section set.

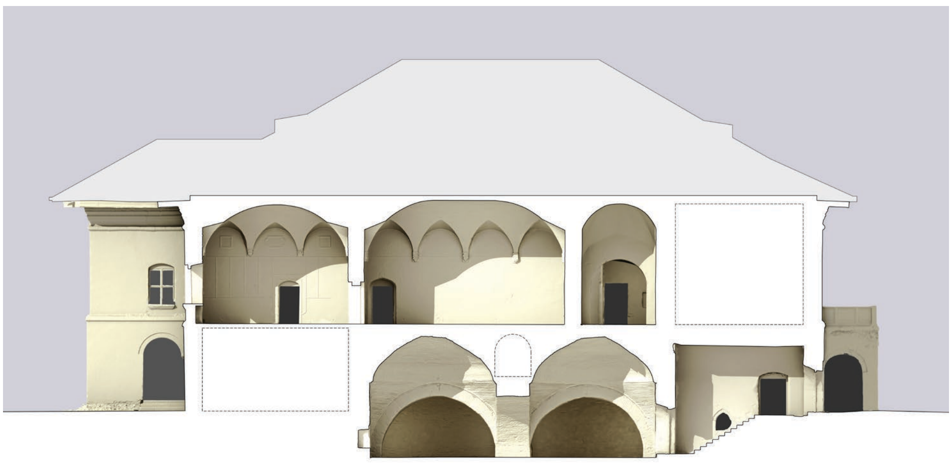

Fig. 38 Sectional elevation.

Fig. 39 Internal view of the loggia; high point density gives detailed representation of individual features.

Conclusions

The first results of this inter-university and interdisciplinary experience led to the creation of a 3D model of Potlogi Palace. The model, characterized by high accuracy and fine details, allowed the historical building to be studied remotely, saving travel expenses and time, and enabling Italian and Romanian scholars to study, plan decisions and interventions, and prepare the programme of investigations to be carried out in the next measurement campaign.

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Bibliography

Alba, Mario and Scaioni, Marco, 'Comparison of techniques for terrestrial laser scanning data georeferencing applied to 3D modelling of cultural heritage', *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, 36 (2007) 5/W47.

Binda, Luigia, Mirabella Roberti, Giulio and Guzzetti, Franco, *San Vitale in Ravenna: a survey on materials and structures*, IASS-MSU International Symposium (Istanbul, 2000), pp. 89-99.

Bonollo, Monica, *La costruzione del vedere. Simulazione Visiva, Realtà Virtuale e Costruzione del Mondo* (Vicenza, 1992).

Brătuleanu, Anca, *Romanian Princely and Nobiliary Courts. The 17th and 18th century Walachia* (Romanian-English edition) (Bucharest, 1997).

Brătuleanu, Anca, 'L'architettura del giardino Veneto e il giardino romeno (XVII e XVIII secolo)', *Dall'Adriatico al Mar Nero: veneziani e romeni, tracciati di storie comuni*, (Rome, 2003), pp. 203-212.

Bryan, Paul, Blake, Bill and Bedford, Jon, *Metric Survey Specifications for Cultural Heritage* (D. Andrew Editor, 2009).

Bezoari, Giorgio, Selvini, Attilio, Borsa, Marco, Mataloni, Giovanni, 'Il castello di Somma Lombardo. Diverse modalità di rilevamento e rappresentazione', *Recupero e Conservazione*, 95 (2011).

Cantoni, Roberto, Vassena, Giorgio and Lanzi, Claudio, *Integrazione tra Laser Scanning e metodologie di rilievo tradizionali nella ricostruzione 3D*, proceedings National Conferece ASITA, (Perugia, 2002).

Carbonara, Giovanni, *Avvicinamento al restauro* (Napels, 1997).

Cerasi, Maurice, 'Città e architettura nel Settecento', *Rassegna*, 4 (1997), pp. 36-52.

Colombo, Luigi, 'Tecnologia e Tecnica nel Laser Scanning Terrestre. Annotazioni per i Beni Culturali', *Archeomatica*, 9 (2011).

Cunico, Mariapia, *Il giardino veneziano, La storia, l'architettura, la botanica* (Albrizzi, 1989).

D'Avino, Stefano, 'Il rilievo computerizzato come modello interpretativo per il restauro', *Contributi*, 4 (1997), pp. 25-30.

D'Avino, Stefano, 'Reale e virtuale. Osservazioni su un complesso rapporto e sue implicazioni nel restauro', in *Inserzioni Disegni*, ed. Carlo Mezzetti (Rome, 2007), pp. 77-87.

De Seta, Cesare, 'Maniere e artifici per narrare l'arte', *Op-cit: rivista quadrimestrale di selezione della critica d'arte*, 125 (2006), pp. 15-21.

Djindjian, François, 'Nouvelles tendances méthodologiques dans le traitement and l'information en archéologie', *Archeologia e calcolatori*, 1 (1990).

Eloueini, Ammar, *L'architecture virtuelle: une nouvelle frontière de l'espace* (Paris, 2002).

Forte, Maurizio and Guidazzoli, Antonella, 'Archeologia e tecniche di eidologia informatica', *Archeologia e calcolatori*, 3 (1992), pp. 38-77.

Ghica Budeşti, Nicolae, 'Evoluţia arhitecturii în Muntenia şi Oltenia', *Buletinul Comisiei Monumentelor Istorice*, 4 (Bucureşti, 1936).

Gregory, Tullio, 'Nel mondo semantico del virtuale', *IF rivista della Fondazione IBM*, 1 (1997).

Guerra, Francesco, Balletti, Caterina, Stevanin, Cecilia and Vernier, Paolo, '3D geometric analysis of the facades of gothic buildings in Venice: examples of 3D modeling', in *Proceedings Italy – Canada 2005 2nd Workshop 3D digital Imaging and Modeling application of: Heritage, Industry, Medicine & Land* (Padua, 2005).

Il giardino veneto, ed. Margherita Azzi Visentini (Milan, 1988).

Maldonado, Tomas, *Reale e virtuale* (Milan, 1992).

Masiero, Roberto, 'I linguaggi dell'autenticità', *ΑΝΑΓΚΗ*, 4 December 1993, pp. 9-13.

Monti, Carlo, Fregonese, Luigi, and Achille, Cristiana, 'Laser scanner application on complex shapes of architecture. Profiles extraction processing and 3d modelling', in *Proceedings of the ISPRS working group V/6 (International archives of photogrammetry, remote sensing and spatial information sciences)*, XXXIV, 5/W10, (Tarasp-Vulpera, 2003).

Santana Quintero, Mario, Lerma, Jose Luis, Heine, Erwin and Van Genechten, Björn, *Theory and practice on Terrestrial Laser Scanning* (Valencia, 2008).

Vecchi, Benedetto, *Nell'ipertesto della realtà* (Milan, 1997).

Illustrations

Fig. 1 Popescu, M., 'Oltenia în timpul stăpânirii austriece', *Buletinul Comisiei Monumentelor Istorice*, iulie-septembrie 1926, p. 105, drawings made by the Austrian Engineer Johann Weiss in 1728-1731.

Fig. 2 Academia Română, the Prints Collection.

Fig. 3 Survey drawing, Drăghiceanu, V., *Buletinul Comisiei Monumentelor Istorice*, 1910; photo author, 1980.

Fig. 4 Photos Liviu Brătuleanu, Horia Moldovan, 2011; drawing survey, Department of History & Theory of Architecture and Heritage Conservation, 'Ion Mincu' University of Architecture and Urbanism.

Fig. 5-39 Virtual models developed by Laboratory of Topography, Department of Architecture, University of Chieti-Pescara.

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[1] Ghica Budeşti 1936.

[2] For the Italian influences, see the bibliography.

[3] This affirmation is the result of on-site research made by the author at Potlogi and Istanbul (edifices built before the end of the seventeenth century).

[4] Bonollo 1992, p. 95.

[5] Forte 1992.

[6] See Carbonara 1997, p. 474.

[7] Forte 1992.

[8] See also Torsello 1999.